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Battelle Technical Review

IN THIS ISSUE: Ozone's Role in Chemistry and Technology

VIGNETTE

HARVEY L. GOERING

There can be little doubt that the so-called solid-state materials with their interesting and valuable electrical and other properties, are important in the progress of many technologies. Scientists know that it is possible to build such materials and compositions to meet specific needs, for transistors, resistors, rectifiers and other semiconductor devices. "The precise tailoring of materials, however," states Harvey L. Goering, "necessitates more fundamental knowledge about the relationship of properties to structures than we now have. The application of physical chemistry principles—relating thermodynamics and kinetics to properties—will lead to greatly increased knowledge of the materials. This knowledge, in turn, will enable us to create more effective and economic materials."

Learning more about the fundamental properties of solid-state materials is a primary interest of Harvey and his colleagues. As chief of the physical chemistry division, he is responsible for diverse studies concerned with discovering those properties. He and his colleagues, for example, have participated in the development and study of lead telluride, indium antimonide, gallium arsenide, bismuth telluride, and other intermetallic compounds with valuable electrical properties. These studies also involved devising methods for preparing high-purity materials and for evaluating their physical and electrical properties. The same types of research are under way on the rare earths, now relatively unexplored, but of great promise in industry.

The interest in high purity has led to the improvement of methods for processing materials by zone and floating-zone methods and for crystal pulling. An improved electron-beam floating-zone technique permits purification of high-temperature metals such as tungsten, tantalum, and those of the platinum family. Other research includes the development of transparent electrically conductive coatings, evaluations of techniques for the zone purification of sea water, studies on uses for tellurium and selenium, and a current investigation of a method for the growth of uranium-oxide crystals.

Harvey joined the Battelle staff in 1950, immediately after he received his Ph.D. degree in physical-organic chemistry from Ohio State University. His undergraduate studies led to an A.B. degree in chemistry from Bethel College.

A member of Sigma Xi, Harvey also is active in the American Chemical Society and the Electrochemical Society. His writings as author and co-author number ten publications.

In the Goering home, Kathryn (8), Donald (6), and Charles (2) keep life busy and interesting for Harvey and Viola, his wife. For his quieter moments of leisure, Harvey turns to reading, music, and sometimes chess. Golf and other sports satisfy the urge for action.

BATTELLE TECHNICAL REVIEW

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BONDING DISSIMILAR METALS

Joining dissimilar refractory metals, long a problem for metallurgists, is being made easier by a new gas-bonding method.

The important steps in the method are illustrated in the bonding of a typical reactor fuel subassembly. The prepared parts—uranium alloy fuel elements, zircaloy strips for cladding, and steel separators, with zircaloy pins inserted—are assembled in a metal container (above). After evacuation and welding, the container is placed in an autoclave (right) where bonding is accomplished by the uniform pressure of helium gas (10,000 psi, with temperatures to 2500 F, depending upon materials) upon the parts in the evacuated container. A typical bond may be seen in the photomicrograph (below). After the bonding is completed, the steel separators are etched out leaving open passages between the clad fuel elements, but with the zircaloy pins remaining to strengthen the assembly.

According to Stan J. Paprocki and Edwin S. Hodge, the method has these adavntages: (1) it produces complex shapes easily; (2) it clads brittle materials; (3) it gives close dimensional control; (4) it clads and densifies cermet materials in a single operation; and (5) it trims fabricating costs as much as half.

Recent studies have shown that gas bonding is valuable in other applications—including preparation of composite metal tubes and corrosion-resistant containers, the compaction of powder-metallurgy parts, and the fabrication of sandwich structures of dissimilar metals.

Materials for Pressurized Water Reactors

Corrosion is minimized in pressurized water reactors, but the problem still needs study. The author discusses approaches to solution of the problem and reports on materials under consideration for improving such reactors.

by WARREN E. BERRY

THE DEVELOPMENT OF corrosion-resistant materials is a continuing problem in nuclear reactor technology. Corrosion products are particularly troublesome in reactors because they become intensely radioactive and spread the radioactivity throughout the reactor. As a consequence, maintenance work must be delayed while the radioactivity is eliminated, and the costly down time of the installation is greatly extended.

Poor corrosion resistance affects reactor operations in other ways, also. Corrosion products deposited in heat transfer surfaces reduce the transfer of heat. The buildup of corrosion products in close-fitting areas causes seizing in drive mechanisms, and corrosion products, by increasing the corrosion and erosion of metal parts, increase the malfunctioning of these parts.

Because the pressurized-water reactor tends to minimize corrosion and the attendant difficulties, it has received considerable attention in the atomic power field. Its greatest advantage lies in the fact that the high-purity water used in PWR reactors does not form long-lived radioactive isotopes; therefore, routine or maintenance work can be performed on components external to the core in a relatively short time after reactor shutdown. Moreover, the solutions of many of the problems associated with high-pressure, high-temperature water are already available because of the experience and knowledge built up in the steam-generating field and they are applicable to pressurized water reactors. Nevertheless, much research is still needed to assure desired efficiency in such reactors.

EVALUATING MATERIALS FOR CORROSION RESISTANCE

The problem of evaluating reactor materials for corrosion resistance can be a complex one. During reactor operation radiolytic decomposition of the water produces oxygen and hydrogen peroxide among other things. These oxidizing agents could conceivably promote corrosion of a number of reactor materials. Obviously, the best method of corrosion evaluation is in an operating reactor. This is an expensive, although often justified, means. The usual procedure is to insert small circulating corrosion test loops into the neutron flux of operating reactors.

Less expensive means of corrosion testing are under nonirradiation conditions and include: (1) circulating loops and (2) static autoclave tests.

Circulating loops, such as the one shown in the figure, can be set up in any conventional laboratory pilot plant area. These loops usually contain all the essential components of the primary circuit of a reactor with the exception of the reactor core and steam generator. Reactor conditions are simulated as nearly as possible and include: (1) water chemistry treatments usually in the form of small hydrogen overpressures and adjustment of pH to slightly alkaline conditions (pH 10) to suppress corrosion; (2) water velocities in the neighborhood of 30 feet per second; (3) water temperatures in excess of 500 F; and (4) pressures to 2000 psi or higher to prevent boiling. Through auxiliary equipment and bypass arrangements such as ion exchange resin beds and feed water makeup pumps, water chemistry and water purity can be maintained throughout the test period. The latter may extend over several thousand hours.

Autoclave tests under static conditions are fairly inexpensive, are relatively simple to handle, and permit screening of a large variety of materials. Water chemistry and water purity cannot be maintained with the same precision as in circulating loop tests. This difficulty can be overcome to some degree by continuous bleeding and replacement of the test water by

means of a small external positive displacement pump.

Fortunately, it has been found through experience that the corrosion rates of most metals and alloys in pressurized water reactors are relatively unaffected by irradiation. Exceptions are the fissionable materials which, because of the metal transmutations, are changed not only in chemical composition but also in physical dimensions. Thus irradiated nuclear fuel materials frequently exhibit very poor corrosion resistance when exposed directly to high-temperature water.

A secondary effect of irradiation on corrosion behavior is the tendency to increase corrosion-product release and redeposition. This results in increased radioactivity of corrosion products since those products which originate outside the core have an opportunity to be carried into the core, become radioactive, and then be carried to some external portion where they are deposited. This radioactivity complicates the maintenance problem and places a heavy burden on the purification system.

The problem of corrosion-product activation must be studied using reactor or machine sources for radiation. However, because of the absence of radiation effects on the corrosion rate of many materials, the wealth of data obtained under nonirradiation conditions can be used for preliminary evaluation of a material's performance.

Applications

The selection of materials for pressurized-water reactors generally is limited to metals and alloys. Nonmetallics, such as ceramics and plastics, become "water logged" or are attacked by the high-temperature water. Notable exceptions are carbon and sintered Al_2O_3 (synthetic sapphire). Uranium and thorium oxides also are resistant to high-temperature water providing certain conditions are maintained.

Applications of materials in the primary reactor coolant side of pressurized-water reactors are divided into several categories. These are summarized in the table on page 5 and include:

1. *Fissionable core materials*—These include fissionable uranium or thorium alloys, oxides, carbides, etc.

2. *Cladding materials*—Included in this group are zirconium and aluminum alloys and austenitic stainless steels. Niobium alloys also are being considered.

3. *Structural members*—Both stainless steel and carbon steel are used in current pressurized water reactors. Zirconium, titanium, and nickel-base alloys also may be used.

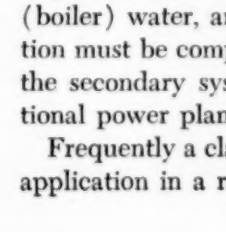
4. *Pressure-containing vessels*—Large vessels such as those housing the reactor core are made of carbon steel or carbon steel lined with stainless steel. Smaller components may be made entirely of stainless steel. Heat exchangers are fabricated from low alloy steels, stainless steels, and nickel-base alloys.

5. *Wear-resistant components*—Applications such as control-rod drive mechanisms, bearings, shafts, springs, and valve stems require hard, strong wear-resistant alloys. Usually these represent only a small fraction of the total surface area in a reactor; thus, in some instances lowered corrosion resistance can be tolerated since the contribution of corrosion product to the total quantity in the reactor is small. These materials frequently are located in colder zones of the reactor, and corrosion is minimized. Thus, there is less opportunity for circulation and activation of corrosion product from a material which spawns long-lived radionuclides, such as cobalt. Other alloys which are used for these applications are martensitic stainless steels, precipitation-hardening stainless steels, and Inconel X.

6. *Control-rod materials*—These materials possess a high degree of absorption for thermal neutrons. They are used in reactor operation to control the neutron density and hence the heat generation by insertion into, or removal from, the reactor core. Hafnium and compounds of boron are used extensively in this application.

Only the steam generators of the primary circuit of a pressurized-water reactor contact the secondary (boiler) water, and the material chosen for construction must be compatible with both waters. The rest of the secondary system is similar to that of a conventional power plant.

Frequently a class of alloys is used in more than one application in a reactor. In the following sections the



Warren Berry has been conducting studies of reactor components and fuel elements for more than a decade. Recently, he has been giving special attention to corrosion problems associated with alloys of zirconium, uranium, thorium, and niobium, and with stainless steels. He has participated also in research on corrosion of many of the metals and alloys discussed in this article. Late in 1959, Berry was a delegate to the U. S. Atomic Energy Commission-Euration Conference on Aqueous Corrosion of Reactor Materials, in Brussells. He contributed to a chapter on corrosion in the recent American Society of Metals publication, *The Metal Thorium*.

general corrosion behavior of alloys in reactor water will be discussed with reference to behavior that may be peculiar to the environmental conditions.

Materials and Their Properties

Uranium and Thorium Alloys

Fissionable materials in pressurized water reactors are encased in a corrosion-resistant envelope (cladding) to protect them from corrosion and to prevent fission fragments from entering the coolant steam. However, if a leak should occur in the cladding, it is imperative that the corrosion resistance of the fuel alloy be known in order to determine the course of reactor operations.

Unalloyed uranium possesses very poor corrosion resistance in high-temperature water. Alloying additions in the range of 10 to 12 per cent niobium or molybdenum stabilize the high-temperature gamma phase and improve corrosion resistance to within acceptable limits. These gamma phase alloys eventually fail by cracking resulting from internal hydriding by hydrogen released during the corrosion reaction. Cladding of these alloys with zirconium results in hydrogen being absorbed by the zirconium and greatly prolongs the life of the core material. Alloys exhibiting a strained alpha structure when quenched from the gamma phase field, such as the uranium-1.5 zirconium-niobium alloy, also have promising corrosion resistance.

Uranium dioxide contains a high percentage of uranium and is resistant to high-temperature water providing the water is free of oxygen. Uranium carbides or nitrides react rapidly with high-temperature water. These may be used in a fuel element as a dispersion in a corrosion-resistant matrix provided that the particles are not contiguous. Thus corrosion would be limited to surface particles in the event of water entering the fuel element.

Although unalloyed thorium is more resistant to high-temperature water than unalloyed uranium, its corrosion rate is excessive at reactor water temperatures (500 to 600 F). Alloy additions in the range of 20 to 30 per cent titanium or zirconium improve its corrosion resistance. However, the corrosion resistance of these alloys does not approach that of the more resistant uranium alloys.

Thorium dioxide is fairly resistant to high-temperature water and appears to be a promising fuel material.

Lightweight Alloys

Of the lightweight alloys, aluminum, beryllium, and magnesium possess low thermal-neutron-absorption cross section and thus would be desirable as fuel cladding materials in pressurized water reactors. However, the corrosion resistance of magnesium is extremely poor in high-temperature water. That of beryllium is somewhat better, while recent developments in improving corrosion resistance of aluminum alloys has resulted in their being considered for pressurized water reactors. Aluminum alloys containing up to 1 per cent nickel and/or iron plus smaller additions of beryllium, titanium, and zirconium are orders of magnitude more resistant than commercially pure aluminum. The latter is reduced to powder after several days of exposure to 600 F water.

Titanium, on the other hand, develops a protective tarnish film and is extremely resistant to high-temperature water. Its corrosion rate is low and is insensitive to coolant flow velocity. The neutron absorption of titanium is relatively high. Therefore it generally is not considered for use as a cladding material. However, its high strength-to-weight ratio makes it an attractive structural material.

MATERIALS OF CONSTRUCTION FOR PRESSURIZED WATER REACTORS

Application	Materials
Fission fuel	Uranium or thorium alloys, oxides, nitrides, or carbides
Fuel cladding	Zirconium alloys, austenitic stainless steels (aluminum or niobium alloys — developmental stage)
Structural members	Austenitic, martensitic, and precipitation-hardening stainless steels
Pressure-containing vessels	Austenitic stainless steels and carbon steels, nickel-base alloys (martensitic and precipitation-hardening stainless steels for valves)
Special applications (wear resistance, bearings, springs, etc.)	Martensitic and precipitation-hardening stainless steels, nickel-base alloys, cobalt-base alloys
Control-rod material	Hafnium, boron compounds

Zirconium and Niobium Alloys

Zirconium has received considerable attention in its development for pressurized water reactors. It has been used as a cladding, structural, and pressure-containing material. It has excellent corrosion resistance, low neutron absorption, moderately good strength, and can be bonded directly to uranium and thorium alloys. The principal alloy of zirconium is Zircaloy 2 which contains 1.5 per cent tin, 0.12 per cent iron, 0.10 per cent chromium, and 0.05 per cent nickel additions to

sponge zirconium (produced by calcium, magnesium, or sodium reduction of zirconium chloride).

The corrosion resistance of zirconium in high-temperature water is sensitive to several variables. More than 50 ppm nitrogen in unalloyed zirconium or several hundred ppm in Zircaloy 2 destroys corrosion resistance. Zirconium getters nitrogen from the air at elevated temperatures and thus must be annealed in inert atmospheres to insure corrosion resistance. Heat treatments which entail slow cooling through the alpha plus beta phase region result in segregation of alloying constituents and loss of corrosion resistance in Zircaloy 2. Failure to rinse the nitric-hydrofluoric acid pickling solution used in surface preparation also destroys the corrosion resistance of zirconium.

High-strength zirconium alloys containing combinations of tin, molybdenum, and niobium have been developed, but at the expense of some loss in corrosion resistance. Ternary alloys containing a total of several per cent alloy additions of combinations of iron, nickel, and chromium appear promising for applications in steam at temperatures in the range of 900 to 1000 F. Copper-molybdenum ternaries also offer promise for these applications.

Hydriding of zirconium and the resulting embrittlement can be a problem in reactor operation. It has been shown that a source of the hydrogen is the corrosion reaction. Nickel additions, one of the alloying elements in Zircaloy 2, have been found to increase hydrogen absorption in sponge zirconium. Currently, investigations are under way to study the feasibility of eliminating nickel from Zircaloy 2 in an effort to reduce hydrogen pickup.

Niobium alloys also show some promise as cladding materials in high-temperature water. As compared with Zircaloy 2, niobium alloys possess almost equal corrosion resistance, greater high-temperature strength, and a higher neutron absorption cross section. Included in the more resistant alloys are a binary 12 atomic per cent vanadium alloy, a ternary 28 atomic per cent titanium, 6 atomic per cent chromium alloy, and alloys containing more than 45 atomic per cent zirconium. Unalloyed niobium is not sufficiently resistant to high-temperature water for cladding operations and does not possess outstanding high-temperature strength.

Ferrous Alloys

The ferrous alloys have been used extensively in structural and pressure-containing applications in pressurized water reactors. The austenitic stainless steels have been used most extensively, although low alloy carbon steels have been included in several installations. The austenitic stainless steels also have been used as cladding material for oxide fuels.

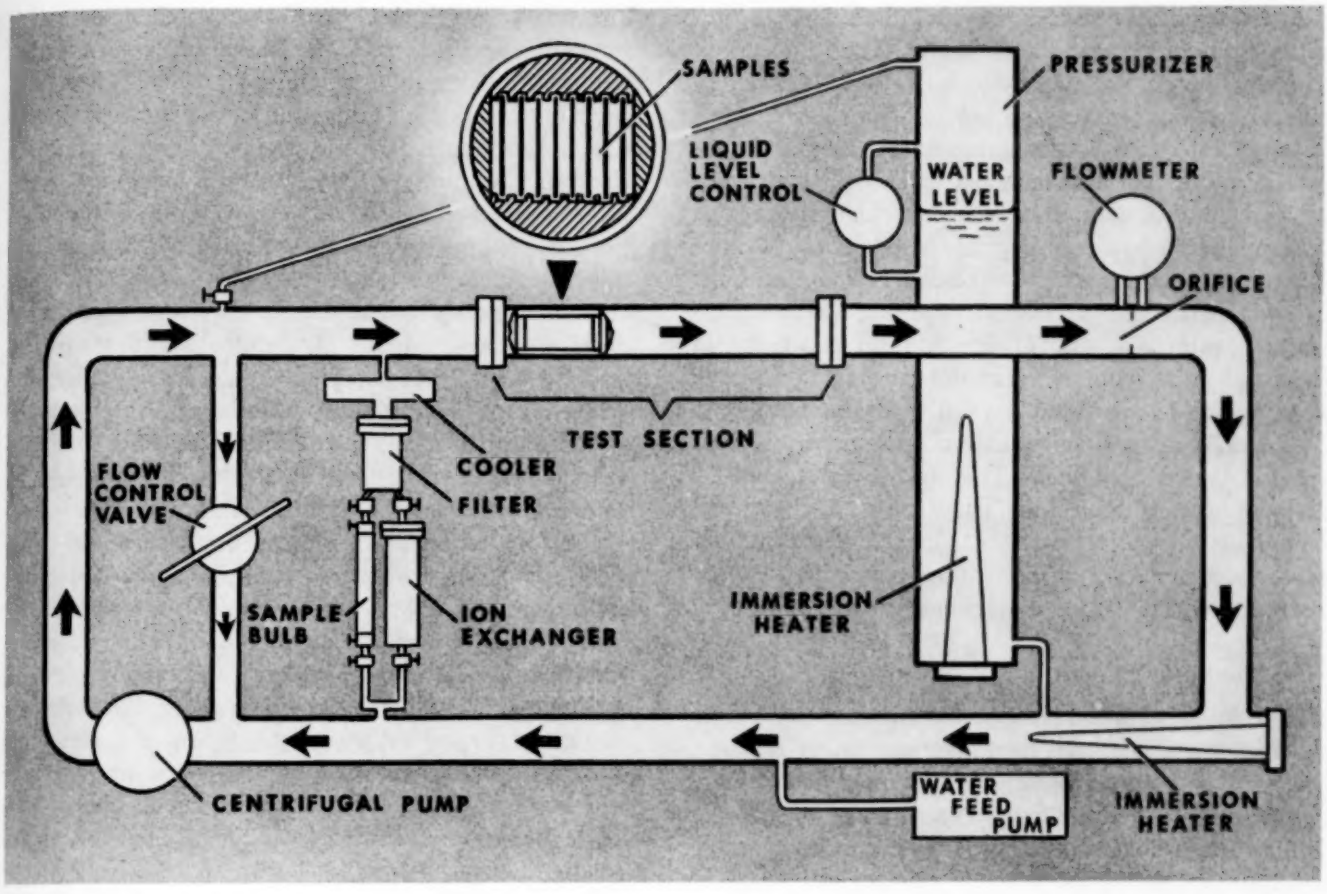
Structural members and pressure-containing materials comprise a large percentage of the internal area of a pressurized water reactor. Thus, it is imperative that these components be corrosion resistant and that loosely adherent corrosion products be kept to a minimum. This avoids: (1) deposition on heat transfer surfaces and (2) induced radioactivity of the corrosion product. The former could cause a decrease in the heat transfer rate which increases core temperature and possibly could melt the fuel element; the latter could cause maintenance problems where deposition occurred in reactor circuits external to the core.

The austenitic stainless steels corrode at a very low rate in primary reactor water. From a structural standpoint the loss in metal is less than 0.00005 inch per year. The rate of attack is not greatly influenced by irradiation, dissolved oxygen in the water, pH in the range of 6 to 11, or water temperature in the range of 500 to 650 F. However, a portion of the corrosion product, which is principally Fe_3O_4, is released to the coolant stream and is transported as small particles. The release and deposition of this product (frequently called "crud") is influenced by several variables. Release and deposition increase with increasing oxygen content in the water, decreasing pH in the range of 7 to 11, and in the presence of irradiation.

The corrosion products on carbon steels are influenced by the same factors which affect those on stainless steels. In addition, carbon steels corrode at a somewhat higher rate in primary water. Although the rate is not significant from a structural standpoint, larger quantities of corrosion product are released to the coolant stream. However, the induced long-lived radioactivity is somewhat lower than in an equal amount of stainless steel corrosion product because of the absence of chromium or nickel in the carbon steel. Dissolved oxygen in the primary water results in pitting of carbon steels in crevices.

The corrosion resistance of chromium stainless steels in primary water is similar to that of austenitic stainless steels. In the hardened condition, the chromium stainless steels may exhibit stress corrosion cracking in primary water. A good quality chromium electroplate is frequently used to avoid cracking in these steels. The chromium stainless steels also pit in crevices in oxygenated water.

The heat exchanger is the only portion of the primary circuit which is in contact with primary water on one side and secondary (boiler) water on the other. Austenitic stainless steels and low alloy steels have been used in this application. Austenitic stainless steels



A circulating loop containing all essential features of the primary circuits of a reactor except the reactor core and steam generator.

possess excellent general corrosion resistance in secondary water, however, they are subject to stress corrosion cracking when chlorides or free caustic are present in the water. It is difficult to avoid chlorides in secondary water. Chlorides in the range of several ppm in the bulk water can become concentrated in crevices associated with heat transfer members and in the presence of oxygen will cause stress corrosion cracking. Caustic cracking is frequently a result of improper water treatment and apparently can be controlled by avoiding the addition of free caustic. Carbon steels do not possess good corrosion resistance in secondary water contaminated with high concentrations of chloride and oxygen. Loss in structural strength and severe pitting are observed under these conditions. Their corrosion resistance is greatly improved if impurities in the water are low. However, dissolved oxygen must also be kept low to avoid pitting in crevices.

The ferrous alloys also are susceptible to crevice corrosion in primary reactor waters. Although oxide buildup over most of the internal surface of a crevice may be slight, frequently a fairly heavy buildup may occur near the crevice opening. This buildup may bridge the opening of the crevice and can result in seizing of moving parts. This form of attack can be kept to a minimum by (1) keeping oxygen in the water at a low value, (2) increasing the size of the crevice openings, and (3) periodic operation of components which normally would remain static for long periods of time.

Austenitic stainless steels have been used as fuel cladding material in specialized reactor applications. Heat transfer does not appear to affect corrosion rates significantly. However, it has been shown that, where several ppm of a strong caustic (NaOH and KOH) are used for primary water treatment, stress corrosion cracking may occur in the stainless steel. The cracking is found in crevices where the caustic is concentrated many-fold above the concentration in the bulk water. There are indications that caustic cracking does not occur in waters treated with LiOH or NH_4OH.

Nickel, Copper, and Cobalt Alloys

Nickel alloys also are used in the primary circuit of pressurized water reactors. Unalloyed nickel is fairly

resistant to primary water provided there is little dissolved oxygen present in the water. The same holds true for Monel, a nickel-copper alloy. Inconel, a nickel-chromium-iron alloy, not only possesses excellent general corrosion resistance in primary and secondary water, but also does not exhibit pitting, stress corrosion cracking, or other forms of selective attack in these media. A hardenable grade of this alloy, Inconel X, is used in springs for pressurized water applications.

Copper-base alloys generally are not used in pressurized water reactors. Their corrosion resistance in degassed primary water is not outstanding, and attack is increased by dissolved oxygen in the water.

Cobalt-base alloys have limited applications in pressurized water reactors. The long-lived cobalt-60 isotope restricts their use. They are used in special components which require hard, wear-resistant surfaces. In general, cobalt-base alloys possess fairly good corrosion resistance in primary reactor water.

Hafnium and Boron

Hafnium and boron compounds are used extensively as control-rod materials in pressurized water reactors. Hafnium exhibits excellent corrosion resistance in high-temperature water and can be used in the unclad condition. Boron is usually incorporated into a corrosion-resistant matrix in the form of boride particles. The matrix is then clad with a corrosion-resistant alloy. Optimum corrosion resistance is achieved when the boride particles are not contiguous.

Unsolved Problems

Although considerable knowledge was already available at the beginning of the pressurized water reactor program and much more has been learned during its development, a number of corrosion problems continue to concern the design engineer.

One of the foremost problems is that of radioactive corrosion product circulating through the reactor. Water treatment has reduced corrosion product transport but has not yet eliminated it. Economical alloys that do not contaminate the coolant have not yet been developed. Present technology has not mastered the task of quantitative removal of this product. Thus, radiation levels continue to build up in reactor circuits external to the core because of the slow decay of the long-lived isotopes. Maintenance in these areas is difficult. The complete removal of corrosion product also would permit more extensive application of a number of alloys presently used in limited amounts because of the radioactive isotopes which they foster.

Economical cladding alloys are still being sought. Zirconium alloys, while possessing excellent corrosion resistance and low neutron absorption, are nevertheless costly. Not only is the initial cost high, but extra precautions must be taken and constant checks made during fabrication to insure freedom from contamination. In addition, a completely satisfactory scrap recovery method has not been worked out. In the interests of economy, high-temperature strength zirconium alloys are being developed. They would permit using thinner cladding and/or higher core temperatures.

Recent developments in aluminum alloys have resulted in significant improvements in high-temperature water corrosion resistance. Aluminum also enjoys the advantages of being relatively inexpensive and possesses a low thermal neutron absorption cross section. However, a serious drawback is its low strength at reactor operating temperatures. Sintered metal products and incorporation of Al_2O_3 in alloys are being investigated to improve high-temperature strength.

Hydrogen absorption in zirconium alloy cladding can lead to embrittlement failures in fuel elements. Factors which influence hydrogen absorption currently are being studied with the ultimate aim of determining the mechanism and the remedial steps necessary to eliminate absorption. To date, nickel additions have been found to increase hydrogen absorption in zirconium alloys. A program is now under way to determine the effects of eliminating the nickel additions from Zircaloy 2.

The upper temperature limit of pressurized water reactors is determined by the critical temperature of water, 705 F. In practical applications the temperature is even lower. In modern power plants, temperatures very much in excess of these are used for economical generation of steam. Higher temperatures are sought for nuclear reactors, also. Gas-cooled reactors are one means of attaining these temperatures. Nuclear fueled superheaters above boiling water reactors may be another means. Progress is already being made in developing zirconium alloys for steam at 1000 F. Perhaps advancements in niobium alloy development may provide a cladding material with the required properties of high strength and corrosion resistance in steam at 1200 to 1300 F.

In spite of the many corrosion problems associated with pressurized water reactors, the technology has been advanced to the point that this type of reactor not only is feasible, but also can be operated successfully with a minimum of malfunctions attributable to corrosion. This fact is attested by the continuous and successful operation of such reactors as the PWR at Shippingport, Pennsylvania, the Army Power Package Reactor, and the Navy submarine thermal reactors.

Ozone's Role in Chemistry and Technology

Research is revealing ozone as valuable in a growing number of applications. Here is a discussion of the properties of the gas, its present and potential uses, and steps that may lead to its wider utilization.

by GARSON A. LUTZ

IF IT WEREN'T FOR A GAS that smells like new-mown hay, man would fry. This bluish gas, known as ozone, forms a protective layer around the earth which extends roughly from an altitude of 50,000 to about 100,000 feet. Ozone filters out most of the harmful ultraviolet rays in the sunlight and enables man to live. Fluctuations in the ozone layer explain, in part, why you may get a bad sunburn one day and not burn the next. Turbulence in the atmosphere causes both density and distribution of the gas to vary from time to time, thus modifying the amount of ultraviolet radiation. Ozone fluctuations appear to correlate with the weather; should a close and reliable relationship between the two be found, it could be useful in improving weather forecasts. Recent studies also suggest that ozone movements may yield data on speed of radioactive fallout.

PHYSICAL PROPERTIES

The odor of ozone was first noticed by Van Marum near an operating electrical machine in 1785. In 1840 Schönbein was able to produce the gas at the anode during electrolysis of water and also in the slow oxidation of phosphorus. Researches during the next forty years led to the recognition that ozone was triatomic oxygen. With the discovery of the ozone layer in the upper atmosphere and its significant role as a ultraviolet shield, the properties and reactions of ozone took on a new importance.

The new-mown-hay odor characteristic of ozone is detectable in air at concentrations of less than 0.1 part per million of air. At ordinary temperatures and pressures ozone is a blue, unstable gas; at —112 C it condenses to a dark blue, unstable liquid. More soluble in water than oxygen, ozone decomposes in the liquid, a reaction which is accelerated by temperature and by increasing hydroxyl ion concentration. Ozone is even more soluble—up to several times its solubility in water—in glacial acetic acid, acetic anhydride, dichloracetic acid, propionic acid, chloroform, and carbon tetrachloride.

Ozone absorbs light at certain wave lengths in the visible and in the infrared, and has a strong absorption maximum in the uleraviolet at about 2537 Angstroms which affords a convenient method of determining ozone concentrations in the laboratory and in the stratosphere. Selected physical and chemical thermodynamic constants for pure ozone are listed in the table on page 11.

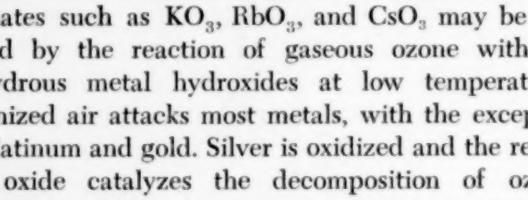
CHEMICAL PROPERTIES

Ozone is a very strong oxidizing agent. Its oxidation potential is —2.07 volts referred to the hydrogen electrode at 25 C and at unit hydrogen ion activity. Only

fluorine has a more electronegative potential (—3.03 volts). In solution, ozone oxidizes arsenite ion to arsenate, chromous ion to chromate or dichromate, ferrous ion to ferric, manganous to manganese dioxide or permanganate, and nitrite ion to nitrate. The oxidation of iodides to iodine serves as an analytical method for the determination of ozone (see below). Ozone is a powerful and fast bleaching agent. It reacts with impurities in water, removing unpleasant tastes, odors, and color, and its also destroys bacteria.

The decomposition of ozone is catalyzed by moisture, certain metallic surfaces, certain metallic oxides, strongly alkaline solutions, hydrogen peroxide, nitrogen pentoxide, bromine, and chlorine. Unstable colored ozonates such as KO_3, RbO_3, and CsO_3 may be prepared by the reaction of gaseous ozone with the anhydrous metal hydroxides at low temperatures. Ozonized air attacks most metals, with the exception of platinum and gold. Silver is oxidized and the resulting oxide catalyzes the decomposition of ozone. Aluminum and stainless steel are the most resistant of the common metals.

In the absence of water, ozone attacks most saturated organic compounds only very slowly at 25 C but it reacts rapidly (even at —50 C) with unsaturated organic compounds forming ozonides at double or triple carbon-carbon bonds. The ozonide obtained from an olefin $R_2C{=}CR_2$ might be represented by the following structures:



These ozonides may be oxidized, hydrolyzed, reduced or decomposed thermally to give aldehydes, ketones, carboxylic acids, and other nonperoxidic products. In most inorganic reactions only one atom of the ozone molecule enters into the oxidation; the other two are released as molecular oxygen. In the formation of organic ozonides, the whole molecule enters into the reaction.

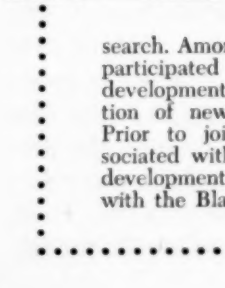
Ozone in the Laboratory

Ozone is produced most effectively both in the laboratory and commercially by the action of an electric discharge on dry air or dry oxygen. The electric current dissociates part of the oxygen, which recombines to form ozone. It has also been prepared by heating barium peroxide with strong sulfuric acid, by heating peroxides in a stream of oxygen, and by the electrolysis of sulfuric or perchloric acid solutions. A new method for making ozone has been developed which gives nearly quantitative conversion of oxygen to ozone. In this method oxygen is passed through a high-frequency electric discharge into a U-tube which is cooled in liquid nitrogen. After the discharge, ozone forms in a narrow band on the wall of the tube.

Ozonolysis Equipment

Because of its intense chemical activity, work with ozone calls for careful selection of laboratory ware. Chemists have come to prefer glass equipment for most laboratory ozonolysis experiments. Short sections of Tygon tubing have been found best for flexible connections. Of several types of reaction vessels available, a standard gas-to-liquid reactor containing an air tight, glass-sleeved, gas inlet stirrer has been found especially satisfactory. A small batch reactor of this type permits a short reaction time and enables the processing of the ozonolysis mixture without transferring the reactor contents. If the ozonolysis is to be carried out at minimum residence time, a counter-current ozonolysis apparatus may be desirable. This internally-fed glass column which contains feed inlets for scrubbing solvent and reactants, has proved useful. Since temperature control is usually necessary, the ozonization vessel should have a cooling jacket or be surrounded with a cooling bath.

Ozonators for producing the gas in the laboratory have a capacity rated at several grams of ozone per hour, with dry air or with dry oxygen as feed. A compact laboratory ozonator usually is comprised of a high voltage transformer, a voltage regulator, voltmeter,



Since his association with the Battelle staff, Dr. Garson Lutz has participated in research on diverse chemical problems. He had a key role in the development of an ion-exchange process for the recovery of uranium from shale and phosphate rock, and has contributed to ozonization studies on butyl rubber, the preparation of electroplating additives, and to rosin and tall oil research. Among other investigations in which he has participated are the utilization of tallow, the development of dye intermediates, and the preparation of new petroleum hydrocarbon derivatives. Prior to joining the Battelle staff he was associated with the Solvay Process Company in the development of dibasic acids and anhydrides and with the Blaw Knox Company.

circuit breaker, pressure valve, pressure gauge, pressure relief valve, and a flowmeter. Dry air or oxygen as gas feed and adequate cooling water are required for favorable operation and consistent performance of the ozonator (see figure on next page).

Analysis

The term "ozone" is generally used to refer to ozonized air or ozonized oxygen. Since ozone is usually present in relatively small quantities, an effective method of analysis is important. The iodometric method for the determination of ozone in ozonized air or oxygen has found wide acceptance because of its dependability. Both neutral and alkaline potassium or sodium iodide solutions absorb ozone efficiently and yield the same amount of iodine. After absorption of the ozone from the desired volume of ozonized gas, the iodide solution is acidified and the liberated iodine titrated with standard sodium thiosulfate solution. The reactions are represented by:

$$O_3+2KI+H_2O=I_2+2KOH+O_2$$

and

$$I_2+2Na_2S_2O_3=2NaI+Na_2S_4O_6$$

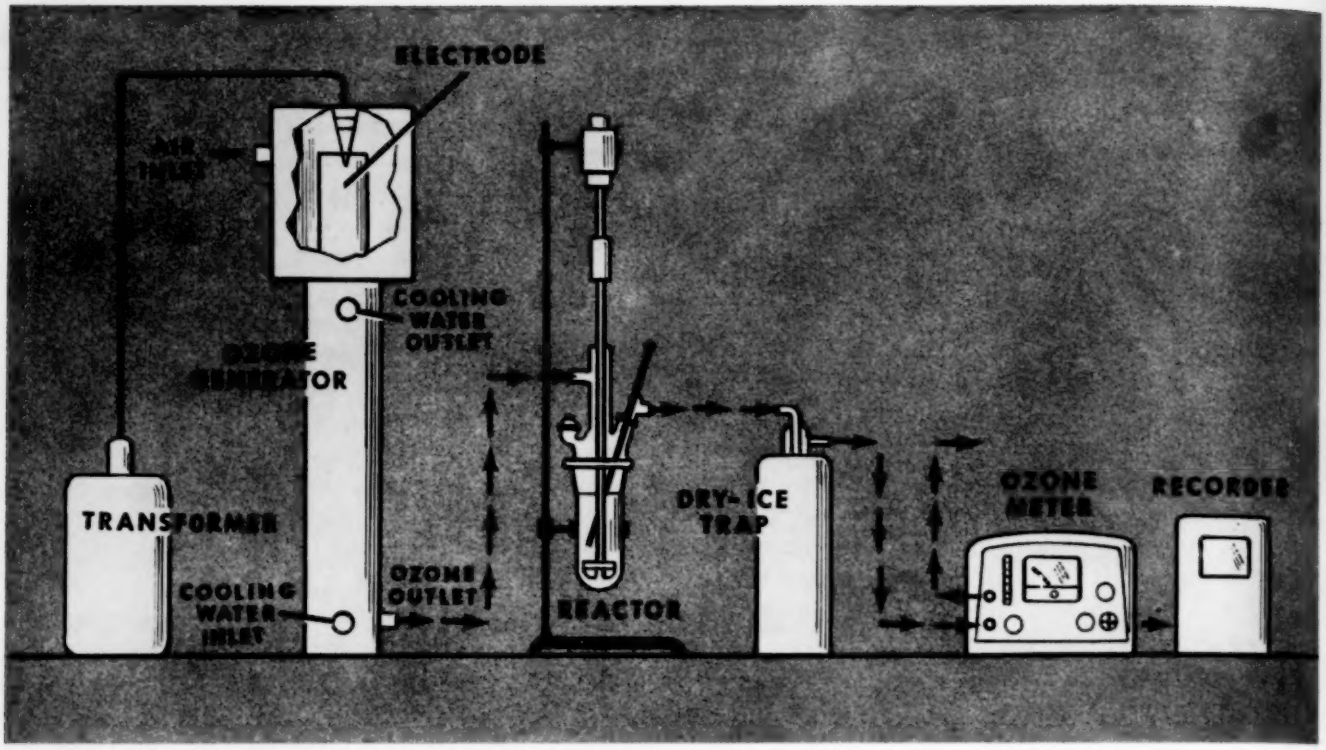
The photometric determination of ozone is based on its strong absorption maximum in the ultraviolet at 2537 Angstroms. The maximum can be determined by measurements on ozonized air or oxygen of known concentration. Using this technique, the determination of ozone is simple. A beam of monochromatic light of the desired wave length is filtered and allowed to fall upon a photoelectric cell. The small amount of current generated by the photoelectric cell is measured twice, once with the cell filled with the feed gas to obtain a reference current and again while the ozonized feed gas is passing through. The imbalance between the two readings gives the concentration of ozone in milligrams per liter of ozonized air. Standard instruments are available which can be readily adapted to making the determinations.

The photometric method is especially valuable where rapid fluctuation in ozone content must be determined. It lends itself to continuous automatic measurement of ozone concentrations from parts per million to several per cent by weight or volume per cent of ozone. Below the convenient range of the iodometric method, the photometric method can be used as a secondary standard in measuring very low concentrations in air or water. A recording millivoltmeter can be employed to record the photometric readings. In this manner, area measurement can be translated in terms of ozone consumption. When employed for the determination of ozone in water, the photometric method has the advantage of being relatively free from interference by other oxidants. An automatic recorder of atmospheric ozone has been developed which gives a direct determination of ozone in the form of a direct-reading curve. Interference from other components is prevented by the fact that ozone dissociates at 300 C.

An investigation of the degradative effects of ozone on elastomeric material led to the development of a technique for the determination of ozone with a non-aqueous colorimetric method which utilizes the rate of color produced on ozonization of o-dichlorobenzene solutions of N-phenyl-2-naphthylamine. It has a practical sensitivity of $\pm$ 1.8 x 10^{-3} mg of ozone. A catalytic ozone analyzer has been developed in which the ozone concentration can be measured by the temperature differential between the two thermistors placed in the gas stream.

PROPERTIES OF OZONE

Molecular Weight	48	
Boiling Point	—111.9 C	Standard Heat of Formation 34,000 cal/mole
Freezing Point	—192.5 C	
Critical Temperature	— 12.1 C	Standard Heat of Formation (aqueous solution) 32,000 cal/mole
Critical Pressure	54.6 atms	
Vapor density at 0 C, grams/l	2.154	
Density (liquid)	1.572g/ml	Standard Free Energy of Solution 38,900 cal/mole
Heat capacity at 25 C.,	at —183 C cal/(gram mole) (C) 9.1	
Heat of Vaporization	3,410 cal/mole at —111.9 C	Entropy 57.1 cal/deg mole
Viscosity (liquid)	1.56 centipoise at —183 C	
Surface tension	38.1 dynes/cm at —182.7 C	
Magnetic susceptibility cgs units:		
Gas	0.002×10^{-6}	
Liquid	0.15×10^{-6}	



The laboratory ozonation equipment shown above illustrates the basic components of all types of such equipment. The steps usually followed begin with the passage of air or oxygen into the ozonator where part is converted to ozone by an electric discharge. The mixture of ozone and air or oxygen then passes into the cooled flask containing the material in a solvent, which is to be ozonized. The amount of ozone being produced is measured by the meter (and recorded) before the ozonization begins; as the ozinization process goes on the reading will once more return to its original level, signalling the completion of the process. The dry-ice trap prevents passage into the meter of the material being ozonized.

Industrial Ozone Generators

Because ozone cannot be packaged for commercial shipments, it must be made where it is to be used. For this reason, a variety of ozonators have been developed for commercial uses.

Industrial ozonators were pioneered in Europe. In 1857 Siemens built the first machine to utilize the ozonator-discharge principle of ozone formation. Modification of this unit led to the prototype of todays' commerical ozonators. From 1907 to 1936, the Otto plate type, the Block type, the van der Made unit, and the Siemens and Siemens and Halske type ozonators were designed for use by municipalities and industries. All commercial ozonators are based upon the principle of the electric discharge through dielectrics which act as stabilizing resistances. There are many variations in detail of shape, dimensions, cooling facilities, electrode and dielectric composition, operating voltage, and frequency. While some laboratory and small-capacity ozonators contain not more than a single pair of electrodes and rudimentary cooling facilities, ozonators with larger capacities and higher concentrations must be furnished with better means of cooling and a large number of electric discharges must be combined in a compact unit. It should be remembered that the ozonator has no moving parts. Units will operate continuously with a life expectancy of about 25 years.

In the United States, ozonators containing multiple units can produce ozone with outputs up to 10,000 pounds or more per day. These ozonators are designed for high concentrations of ozone and for operation on air or oxygen feed. The commercial generators are constructed with stainless steel tubes fastened into a stainless steel shell which functions as a cooling-water jacket. A special glass dielectric is mounted concentrically in the precise center of each tube. The standard glass dielectric tube is coated on the inside with an electrically conductive material. During operation, dry air or oxygen passing through the annular space between the outside of the glass tube and the inner surface of the stainless-steel tube is partially converted to ozone by the discharge across the annulus. Current is stepped up to about 15,000 volts for the conversion. Manifolds placed at the ends of the ozonator may be employed to distribute the feed gas to the discharge spaces and collect the ozonized gas.

Feed Gas Requirements for Ozonators

Either oxygen or air feed can be used for the production of ozone. Where tonnage oxygen is available it provides a particularly economical supply gas. At the same power output approximately twice as much ozone is generated from oxygen as from air so that electrical costs and equipment are greatly reduced when oxygen is used. Air feed is usually preferred where ozone requirements are moderate. For larger plants, recycled oxygen feed is often more economical. Sometimes the choice is dictated by the end use. For example, in some operations the presence of oxygen in the final product might be undesirable; in such cases air feed is likely to be a better choice. With air, a small amount of nitrogen pentoxide may be formed along with the ozone. If this cannot be tolerated, scrubbing may be required. Transfer of the ozone from the ozonized gas to a refrigerated absorbent for desorption, as needed, would be another alternative.

Auxiliary Equipment

For plants using oxygen as a gas feed, the auxiliary requirements depend largely upon the quality and source of the oxygen. Oxygen drawn from a liquefaction distillation column may be used without drying. Since economic factors probably would require recovery and recycle of oxygen, however, a compressor, cooler, and dessicant-type dryer also may be required. Oxygen contaminated with ozone-sensitive materials may require additional upgrading, such as a catalytic burn-out, to meet feed specifications.

Where plants are to be operated on air, an air filter, compressor, cooler, and drier are required. Cartridge-type filters are economical for small plants and electrical precipitators are preferred for large-scale operations. Rotary blowers are employed to compress the air. Moisture can be removed from the feed gas by a combination of cooling and adsorption facilities, including a refrigerant and dual-tower driers of silica or activated alumina as dessicant. A dryness corresponding to a dew point not greater than —60 F is recommended.

Power Requirements and Cost Data

Eight to nine kw-hr are required to generate one pound of ozone from dry air at approximately one-per-cent concentration. Four to five kw-hr of electrical energy are needed to generate one pound of ozone from dry recycled oxygen or oxygen on a one-through basis at about 2-per-cent concentration.

Since ozone may not be transported in gaseous or liquid form, its cost must be based upon factors that enter into its manufacture *in situ*. In very large plants, and under conditions where oxygen feed gas is of a by-product source, the cost of generating a pound of ozone may be $0.10 or even less; in small installations the cost components in ozone production are concentration, electrical energy, and fixed charges on the plant investment in ozone generators and auxiliary equipment. The fixed-charge component will depend upon plant size, amortization policy, feed used, and load factor. Other components affecting the cost, but usually of less critical importance, are labor, supervision, and maintenance costs, and charges for steam, feed gas, and cooling water.

Applications

As the advantages begin to outweigh the problems in the manufacture and handling of ozone, the outlook for its uses brighten. In addition to possible savings, ozone is advantageous in many processes because it reacts rapidly, adds nothing but oxygen, and is generally specific for carbon-to-carbon double bonds. Some applications are discussed below.

Water Purification

The first important industrial use of ozone was as a germicide for water. More recently its use has been extended to the removal of impurities by means of oxidation. Thus, ozone not only sterilizes water but also eliminates many unpleasant odors, colors, and tastes. For these reasons ozone has been able to compete with the cheaper chlorination method for the destruction of impurities in water.

The world's largest ozone plant for the treatment of water is in use at the Belmont Water Treatment Plant in Philadelphia. From 1950 to 1955 an average of more than 10 billion gallons per year of presettled water from the Schuylkill River were treated with ozone. The process involves diffusing ozonized air (containing 1.5 ppm ozone) into water at a depth of about 18 feet while it is in underground contact chambers. At maximum flow, the theoretical contact time is about 10 minutes. Ozone-generating capacity of the plant is 1250 pounds per day, or 25 pounds for each of the 50 generators used. About 2,000 gallons of coolant water is required for each pound of ozone produced. Electric current use averaged about 150 kw-hr for each million gallons of water treated. Operational and overhead costs for this plant, operated at 80 per cent of capacity and depreciated over 25 years, would amount to about 50 to 60 cents per pound of ozone produced. Yet recent improvements in ozone technology give virtual assurance that today's plant costs will be less.

Oxidation of Plant Wastes

Waste disposal is currently an important problem in many industries. Experience suggests that the use of ozone may be helpful in solving many such problems. Thus, the powerful oxidizing properties of ozone have been utilized for the destruction of phenols in coke-plant ammonia-still wastes and phenolic effluents from oil refineries and for the treatment of plating-room waste solutions. Research has shown also that the destruction of toxic cyanides in industrial waste waters is rapid and complete when they are treated with ozone under the proper conditions. Undoubtedly ozone would be found valuable in the treatment of other types of wastes.

Control of Atmospheric Odors

The abatement of industrial odors is another area in which ozone has been proved effective. It has been used successfully for the abatement of the odors of sewage, and of fish in feed and fertilizer plants, and for the control of paper-mill and commercial cooking odors. Minute amounts of the gas are effective in destroying odors in both commercial and industrial refrigerators. Its use in air conditioning has achieved some recognition. Most investigators agree that the low concentrations of ozone required for this purpose have no germicidal or physiological effects and that the deodorizing action is generally a masking action.

Bleaching

Since it is a powerful aid to oxidation, ozone has proved useful as a bleach for some products. It has been used commercially for the bleaching of cotton textiles, yarns, and fabrics. It can be substituted for hypochlorite in the final stages of bleaching of sulfite and sulfate pulps. It can be used also to bleach waxes and oils if the concentration of the gas is low and over-treatment is avoided.

Intermediates for Polymers and Lubricants

Probably the greatest advance in the utilization of ozone has been in the production of carboxylic acids by ozonation of compounds with olefinic double bonds. Using oleic acid, this reaction may be expressed in the following equation:

$$CH_3(CH_2)_7CH{=}CH(CH_2)_7C00H + Solvent + O_3 \rightarrow$$

$$CH_3(CH_2)_7\,CH\!-\!O\!-\!O\!-\!CH(CH_2)_7C00H \xrightarrow[CATALYST]{O_2} \rightarrow$$

The ozonide can be decomposed with oxygen, usually catalyzed by ozone or metal salts:

$$\underset{\text{PELARGONIC ACID}}{CH_3\,(CH_2)_7\,C00H} + \underset{\text{AZELAIC ACID}}{H00C(CH_2)_7\,C00H}$$

Azelaic and pelargonic acid derivatives are used in the field of lubricants as low-temperature plasticizers for vinyls to maintain flexibility under cold conditions, and as extenders in polymeric plasticizers. In Japan, the ozonolysis of oleic acid obtained from sperm oil has served as a commercial process for the intermediates in nylon 9 synthesis. Another Japanese company has developed a fiber called Urylon, in which azelaic acid is a key intermediate. Ozone has also been used to prepare adipic acid, the key intermediate in the synthesis of nylon; and pinic and pinonic acids, esters of which have excellent plasticizer and lubricant properties. Ozone treatment makes polyethylene surfaces more receptive to printing ink or lacquer.

Perfumes, Flavors, Pharmaceuticals

Rose, spicy hay, violet, and amber types of aromatics can be synthesized from terpenes by methods employing ozonization. This opens up an economical route for the preparation of new products for the perfume and pharmaceutical industries. Ozonolysis reactions have also been used for the preparation of anisaldehyde from anethole, piperonal from isosafrole, vanillin from isoeugenol, and p-methoxyphenylacetaldehyde from estragole. Improved yields of aromatic aldehydes have been reported from the ozonolysis of aromatic substituted olefins by employing a rapid steam distillation of the freshly ozonized starting material. The preparation of steroids, too, has been facilitated by the use of ozone.

Rocket Fuels

Experience in the handling of potentially explosive liquefied gases is removing one of the obstacles to the use of ozone as a component in rocket fuels. Liquefied ozone, along with liquefied hydrogen, oxygen, and fluorine plays a vital part in the liquid-propellants picture. Ozone has been used in oxygen as a high-energy oxidizing agent. Because of its instability at concentrations of 30 per cent or more, adidtions of ozone to oxygen have been limited to 25 per cent. There is some evidence, however, that ozone prepared from highly purified oxygen may be handled even in 100-per-cent concentrations.

Miscellaneous Reactions

The reactions of ozone with tertiary amines, arsines, phosphines, sulfides, and sulfoxides lead to oxides of

the first three and oxides or higher oxidation products of the last two. Ozonolysis played an important part in the synthesis of strychnine. The ozonolysis of aromatic and heterocyclic compounds leads in many cases to opening of the ring structures with the formation of simple to rather complex degradation products.

Ozone as an Analytical Tool

The final aspect of the usefulness of ozone to be discussed here concerns its value as an analytical tool. One of its best-known uses in this field is in the proof of structure of selected olefins. In this connection, characterization of the decomposition products of the ozonide generally is sufficient to reconstitute the unknown starting material. By proper choice of experimental conditions, the unsaturation of various synthetic rubbers can be determined. The amount of ozone reacting with the rubber to give a stable ozonide under selected experimental conditions may serve as a yardstick of unsaturation. In other cases, it may be possible to measure the rate of absorption of ozone by various compounds and identify the type of compound or mixture, as the case may be, by the shape of the absorption curve. Ozone has also been used in the study of the degradation of rubber and in the determination of the degree of unsaturation in polymers. By characterization of the ozonolysis products of rubber polymers and copolymers, considerable information has been obtained about the polymer network.

Problems Associated with Ozone

Conflicting reports have appeared as to the actual toxicity of ozone. These discrepancies have been due in part to the use of crude ozonizers with fluctuating current densities, contaminants in feed gas, and the use of unreliable methods of analysis, and organic materials readily attacked by ozone.

Repeated exposures to 2 to 3 parts per million by volume of ozone induced some hemorrhage and edema in lungs of rats. Chronic exposure to ozone decreased the weight gain of young rats, and concentrations greater than about one part per million significantly affected their growth. Four factors that seem to modify the toxicity of ozone toward small animals are youth, physical exertion, alcohol, and respiratory infection. Studies on the toxic effect of ozone on man indicate that concentrations as low as two parts per million may cause severe irritations of the respiratory tract within less than one hour. Edema seems to begin in man at concentrations above 5 parts per million and exposure times in the range of one hour.

Liquid ozone especially in concentrations greater than 30 per cent by weight is extremely unstable and will explode in a most violent and, usually, unexpected way. In handling liquid ozone, all the precautions for liquid oxygen, plus the precautions for an extremely sensitive explosive are necessary. Generally, ozonides are unstable and should be handled with great caution until reliable studies of their stability have been made. The uncontrollable decomposition of ozonides is frequently accelerated by impurities and elevated temperature.

Ozone (as present in the atmosphere) has long been recognized as the culprit that contributes to the cracking of the surface of many synthetic rubber products. This difficulty often can be avoided by the judicious selection of elastomers and compounding ingredients. Especially effective in delaying and reducing the action of ozone are certain aromatic and heterocyclic amines and sealants when they are incorporated into the rubber.

The Future of Ozone

Despite the many reported applications of ozone, its major growth pattern appears to lie primarily in the chemical, industrial waste, and rocket fuels areas. Ozone would be used more widely if its handling problems could be solved. Studies of the adsorption of ozone on silica gel indicate that it may be shipped if absorbed to a concentration of not more than 10 per cent and if the gel is suitably refrigerated. Obviously, failure of the refrigeration system during shipment of the material might be disastrous. Additonal research directed toward (1) separating ozone from the carrier gas, and (2) making it a safe, shippable commodity would open new fields of application for this unusual chemical.

NOTES from BATTELLE

✱ FABRICATING COLUMBIUM

Metallurgists know that columbium and a number of its alloys can be fabricated at room temperature once their cast structures have been broken down. Hitherto the breaking down has been done by forging and rolling at temperatures above 2000 F. Columbium reacts rapidly with air at these temperatures to the detriment of its fabrication qualities making it necessary to protect the metal in some manner during fabrication.

A fabrication method which minimizes the need for such protection has been described by John A. DeMastry and Ellis L. Foster, Jr. In this technique, cast structures of columbium-chromium, -molybdenum, -zirconium, -titanium-chromium, and -titanium-molybdenum are first prepared by inert-atmosphere, consumable-electrode arc-melting processes. The cast structures are then broken down by upset forging them at about 1000 F. At this temperature atmospheric contamination is scarcely a problem. Once the cast structures are broken down, the alloys can be worked at room temperature. Already applied to four-pound ingots, the technique appears practicable for larger ingots, also.

✱ CATALYST FOR AUTO EXHAUSTS

An experimental automobile muffler, using a novel catalyst, has been highly effective in laboratory studies directed to the elimination of smog-producing hydrocarbons from exhaust gas. Work on the muffler is being supported by Arvin Industries. Underscoring Arvin's interest in the problem is the mounting evidence that hydrocarbons from auto exhaust gases are a major cause of smog in urban areas. In Los Angeles, for example, authorities have recently estimated that automobile exhaust accounts for almost two-thirds of the smog.

Dr. Louis J. Hillenbrand, Jr., leader of the Battelle group conducting the research, states that the catalyst is "unlike any reported by others working on this problem". Most important, the muffler's catalyst does not appear to be deactivated or "poisoned" by lead additives in gasoline. Lead additives, an essential component of modern automobile fuels, have long been the stumbling block in efforts to develop a widely useful catalyst for elimination of hydrocarbons. A number of catalysts are available for removing hydrocarbons from exhausts of engines operating on unleaded gasoline, Dr. Hillenbrand explains, but the presence of lead compounds in gasoline has greatly complicated the search for a practical catalytic agent.

Warren C. Ellis, chief of the organic chemistry division where the work is being conducted, emphasized that, thus far, the catalytic muffler has been used only in laboratory experiments with a one-cylinder engine. There are many questions concerning the practicability of the device that cannot be answered until a full-size model is installed on an automobile for evaluation. Variations in hydrocarbon content of exhaust gas, caused by acceleration and deceleration of the engine, complicate the performance requirements for the catalyst, he cautioned.

"The laboratory study has been quite promising", Dr. Hillenbrand concludes. "Later this year, when we hope to evaluate the catalytic muffler on a car, we will be in a better position to forecast the in-service life and performance of the device."

✱ ELECTROGRAPHIC PRINTING

The decorative value of plated parts is only as good as the corrosion resistance of the coatings, and corrosion resistance depends upon the absence of porosity. For this reason, a dependable and accurate method of detecting porosity is important. A number of techniques have been developed, but most of them fail to reveal the relative size of defects or do not permit rapid comparisons with existing visual records.

A recently improved technique for detecting defects in plating and other types of coatings—electrographic printing—provides accurate, permanent mirror images of the defects and enables prompt comparison with visual records. Hugh R. Miller and E. Burt Friedl describe the improved technique. It involves the use of a "sandwich" with the specimen in the center. On the plated side of the specimen are placed dye-transfer photographic paper and white blotting paper saturated with electrolyte, plus a brass pressure platen to serve

as the cathode. The other side of the specimen is backed by a stationary brass platen to conduct current to the metal specimen, which is the anode.

The printing is actuated by a potential of 1.5 to 6.5 volts of direct current, applied for up to a few minutes. Since the body of the specimen is anodic, cations from the underlying metal pass through cracks and pores in the protective coating. They enter the gelatinized surface of the dye-transfer paper and react with appropriate chemicals in the electrolyte to form colored precipitates or soluble complexes. Cracks appear as lines and pores as dots.

The chemists report that the improved technique saves both time and effort in research and in quality-control work. Moreover, the permanent record enables investigators to eliminate much of the human error usually found in evaluating coating discontinuities.

MORE EFFECTIVE COOLING

A broad research program to identify cooling systems that may improve the over-all effectiveness of ground-based Air Force electronic equipment has just been initiated at Battelle. The one-year study, authorized by the Air Research and Development Command's Rome Air Development Center, will cover well-established refrigeration techniques as well as experimental ones.

Rollin J. McCrory, who is directing the program, reports that specialists in refrigeration, combustion, thermodynamics, fluid dynamics, heat transfer, physical chemistry, solid-state physics, organic chemistry, and electronics will contribute to the search for improved cooling techniques. Given "the broadest possible specifications", they will consider such devices as high-speed centrifugal compressors, Peltier cooling units, and the Stirling and azeotropic cycles. One goal of the program will be to conceive new cooling techniques. Where possible the assistance of manufacturing organizations and other research groups known or believed to be working on advanced cooling techniques will be enlisted, also.

The program has been launched with an extensive literature and patent art search. Cooling systems identified in this state-of-the-art search will be appraised for suitability in developing lighter, smaller, and more efficient refrigeration systems for ground-installed electronic equipment, such as the compact mobile units used to control and track aircraft. In the study, no limitations will be placed on the type of power used in cooling systems. Electric motor drive, integral power sources such as the combustion of fuels, direct use of electricity, as well as waste heat from engine exhaust will be considered.

EXTRUSION CLADDING

A new extrusion-cladding process, which is applicable to both simple and complex shapes, has been described by A. M. Hall, chief of the Institute's alloy-development division.

To clad by the extrusion process, Hall and his coworkers feed the core material through a hollow mandrel converging upon a die. The mandrel is housed inside a chamber containing rams that are used to extrude the cladding material. The cladding material is forced through ports located in the chamber between the terminal end of the mandrel and the die. Both the core and the cladding are heated in the extrusion chamber and then pass through the die simultaneously. The process could be operated on a continuous basis.

Hall pointed out that, because the die governs the shape of the cladding, the cladding need not be the same shape as the core. In their four years of development work with the process, Battelle metallurgists have produced a wide variety of cladded products, ranging from simple rods to hollow cores overlaid with cladded fins.

Much of the Battelle work has involved aluminum-clad steel. The process can also be used to clad aluminum on copper and nickel and alloys of these metals.

Hall states that the new process appears to offer three distinct advantages. First, it permits close dimensional control over the cladded product; second, it permits a strong bond between the core and the cladding material; and third, the cladding does not have to be the same contour as the core. In addition, the process permits the cladding of many complex shapes which cannot be clad by standard methods. Conventionally, simple shapes like rounds and tubing are clad by "rolling" or "sinking" a tube of the cladding metal over the rod or tube serving as a core.

The nature of the process, Hall adds, makes it possible to produce integral bonds; simple mechanical bonds; and sheathing effects, where an actual bond is not desired. The sheathing effect points up the possibility, the metallurgist observed, for metal cladding a core that has been coated with a nonmetallic material. If the nonmetallic selected were an electrical insulator, a transmission line could be produced with

an outside metal casing that was resistant to corrosion and other destructive forces. The metallurgist also foresees the possibility of using the extrusion process to produce heat exchanger tubes for use in corrosive atmospheres and decorative load-bearing rods for architectural effects.

CREASE-RESISTANT COTTONS

The good shape-retention qualities of synthetic-fiber garments has led to research to develop the same qualities in cotton fabrics. Currently, polymethylol compounds based on urea-formaldehyde, melamine-formaldehyde, and cyclic ethylene-urea resins are used to enhance the crease resistance of cotton. Cottons treated with such finishes suffer from certain shortcomings—finishes are not permanent and impregnated cottons tend to retain chlorine and show reduced tear strength, tensile strength, and abrasion resistance.

Other compounds show promise for improving the qualities of cotton textiles. Among these are diaziridinyl compounds, which have been under study since 1958, for the U. S. Department of Agriculture's Southern Utilization Research and Development Division, New Orleans. Faber B. Jones, H. George Hammon, Robert I. Leininger, and R. G. Heiligmann have reported a preliminary investigation of several organic aziridinyl compounds of the type obtained by reaction of ethylene imine with organic acids, isocyanates, and chloroformates, which improve the crease resistance of cottons. They theorize that such finishes, when applied to the fabric, react to form cross-linkages and to polymerize to an insoluble network structure in and around the fibers.

Of the groups of compounds studied, the chemists found the diaziridinyl derivatives of hexamethylene diisocyanate and mono- and diethylene glycol bischloroformate greatly improved the crease resistance of cotton-print cloth though chlorine retention is somewhat of a problem. The finishes can be applied to fabrics from aqueous solution or by means of dispersion with conventional padding equipment. The finish is then reacted by drying the impregnated fabric and curing at elevated temperatures.

* The seventh supplement of the *Annotated Bibliography on the Use of Organolithium Compounds in Organic Synthesis* is now available. The current supplement, prepared by Florence A. Emert, Robert W. Gibson, Jr., and Ralph L. Darby for the Lithium Corporation of America, contains 487 abstracts of papers. Copies may be obtained from the Lithium Corporation of America, 500 Fifth Avenue, New York 36, New York, at $2 each. A limited number of earlier supplements are still available.

* Recently appointed: *Dr. Horace J. Grover,* staff physicist in the Institute's Department of Mechanical Engineering. He will be concerned with advanced research on the properties and mechanical behavior of materials, and with new and expanding technical areas of departmental interest.

George McClure, chief of the Institute's applied mechanics division. He will direct research in design and stress analysis and in studies of fatigue and other properties related to design problems.

* Battelle staff members recently named to technical posts include: *Richard E. Bowman*—member, Committee 7, on Evaluation of the Department of Defense Review, Materials Advisory Board, National Academy of Sciences—National Research Council; *Winston H. Duckworth*—member, Panel on Refractory Inorganic Nonmetallic Structural Materials, Materials Advisory Board, NAS-NRC; *William R. Meagher*—member, Technical Committee for Starches and Pentosans, United States Department of Agriculture; *Lewis B. Sibley*—chairman, Roller Bearing Subcommittee, Research Committee on Lubrication, American Society of Mechanical Engineers; *Clyde R. Tipton*—member, Atomic Energy Advisory Committee, State of Ohio.

* Recently honored for their contributions to research and technology:

John D. Sullivan, recipient of the Bleininger Memorial Award, of the Pittsburgh Section of the American Ceramic Society, for his "distinguished achievement in the field of ceramics".

E. E. Slowter, recipient of the Distinguished Alumnum Award from Ohio State University's College of Engineering "For his creative and inventive genius, his executive and administrative accomplishments, his contributions to the engineering profession through research, and his support of engineering education . . ."

Writings by STAFF Members

American Foundrymen's Society, Transactions, American Foundrymen's Society, Des Plaines, Illinois, v. 67, 1959, contains the following writings by staff members:

Some Principles for Producing Sound Al-7Mg Alloy Castings. W. H. Johnson and J. G. Kura, pp. 535-552.

Principles were developed from a study of the relationship that exists between the thermal gradients at the center line of the casting, and various conditions such as the size of the casting as well as the location gates, risers, and chills. It was found that the feeding range of a side riser decreased as the section thickness increased. Unsoundness occurred when the thermal gradients fell below 5 F per in. The feeding range of an end riser was increased by 50% or more by using wedge-shaped chills on the drag surface of the casting.

Foundries Can Produce Their Own Cast Iron Directly From Ore. H. W. Lownie, Jr. and A. J. Stone, pp. 1-8.

Foundries might use some recently developed direct-reduction processes for producing their iron. Some of these processes are suitable for integration into a foundry to replace the conventional cupola facilities and other melting auxiliaries. Under some conditions which exist in iron foundries today, these processes can be used to produce and melt iron more cheaply than by the present conventional methods.

Gray Cast Iron Machinability Quantitative Measurements of Pearlite and Graphite Effects. W. W. Moore and J. O. Lord, pp. 193-198.

Common types of unalloyed cupola-melted gray cast iron were studied to determine how changes in some of the major constituents of their microstructures affected machinability. The objective of the study was to make a contribution to the understanding of fundamental and basic factors affecting the machining ease of gray cast iron.

Radioisotopes Utilization in the Foundry Industry. M. Pobereskin and D. N. Sunderman, pp. 271-276.

Applications of radioisotopes in the metals industry include measurement of wear of cutting tools, bearings and refractory surfaces, tracing of chemical and physical species through complex processes, measurement of thickness of solid and fluid metal and surface coatings, corrosion, location of alloying elements in microstructure and the diffusion of metals in alloys.

Ductility and Strength of High-Carbon Gray Irons. E. M. Stein and H. O. McIntire, pp. 179-186.

Irons melted by cupola, induction and blast furnace were included in the study. The criterion of ductility was the total elongation reached before fracture. Ductility decreased with increasing Mn contents above 0.5%.

An Evaluation of the Properties and Behavior of Zirconium-Uranium Alloys. Arthur A. Bauer. U. S. Atomic Energy Commisison, BMI-1350, September 28, 1959, pp. 119.

Data from a survey of the literature and other available information are reviewed. Constitution, microstructure, mechanical and physical properties, fabrication procedures corrosion behavior, and neutron-irradiation effects are described.

Hydrogen Pickup During Corrosion of Zirconium Alloys. Warren E. Berry, Dale A. Vaughan, and Earl L. White. U. S. Atomic Energy Commission, BMI-1380, September 24, 1959, pp. 16.

Several factors such as alloy composition, hydrogen content of the alloy, surface hydrides, and hydrogen content of the water have been investigated for their effect upon the amount of hydrogen picked up by zirconium alloys during corrosion in 680 F water. Metallic additions of nickel increase hydrogen pickup, antimony, chromium, and iron appear to decrease the hydrogen pickup, while the addition of tin has little or no effect. The hydrogen content of the metal (50 to 400 ppm) or of the water (0 to 2 atm of hydrogen pressure) does not appreciably change the amount of hydrogen picked up by the alloy studied.

Free Energies of Formation of Gaseous Uranium, Molybdenum, and Tungsten Trioxides. R. J. Ackermann, R. J. Thorn, Carl Alexander, and Marvin Tetenbaum. *Journal of Physical Chemistry*, v. 64, March, 1960, pp. 350-355.

Measurements of the vapor density in equilibrium with molybdenum trioxide and uranium oxide are performed by means of means of the transpiration method with oxygen employed as a carrier gas. The standard free energy of sublimation in calories per mole of gas for molybdenum trioxide is given over the temperature range 980 to 1060 K. by the equation $\Delta F^\circ_s = (87.8 \pm 1.0)\ 10^3 - (73.0 \pm 1.0)\ T$ cal. mole $^{-1}$, in which the polymeric species in the vapor are recognized. In the case of uranium oxide variation of the oxygen pressure in the carrier gas establishes the oxygen-to-uranium ratio equal to three for the volatile uranium oxide molecule. By a comparison with the entropies of sublimation of molybdenum and tungsten trioxides it is inferred that gaseous monomeric uranium trioxide is the principal species produced by the reaction of U_3O_8 with oxygen. Although the vapor may not consist entirely of monomer, the standard free energy of formation in calories per mole of this gas over the temperature range 1230-1700 K. can be expressed by the equation $\Delta F^\circ f = 198{,}500 + 19.0T$ cal. mole $^{-1}$.

Remarks on Ferromagnetic Substances With Hexagonal Crystal Structure. E. Ascher (*In French.*) Remarques sur les substances ferromagnetiques a structure cristalline hexagonale. *Helvetica Physica Acta*, nos. 6-7, 1959, pp. 459-462.

A short discussion of crystal anisotropy in hexagonal crystals is presented. Conclusions are drawn regarding the retentivity, coercivity, and initial susceptibility of such substances. On the bases of the following expression for the anisotropy energy: $f = K_1 \sin^2\theta + \sin^4\theta$, it is shown that in a material consisting of randomly oriented crystals of hexagonal symmetry, the (relative) remanent magnetization Mr/Ms may attain values at high as 0.933.

Network Analyser of the 50 Cycles Single Phase Railway Systems. M. Bernard and L. Pun. (*In French.*) Table a calcul pour la traction monophasee 50 Hz. *Proceedings of the 2nd International Analogue Computation Meetings*—September, 1958, pp. 8.

Describes a network analyser developed in the Geneva laboratories for the French National ailway Society. It is used to study mainly the voltage drops across the catenary lines and the location of the power substations. It contains simulators of power substations, catenary lines including mutual coupling, and different types of locomotives. The parameters of the simulators can be adjusted within wide range. The ac measuring system operates at 400 cps with an accuracy of about 1%.

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The Effect of Light of Various Lengths on the Rate of Oxidation of Linseed Oil. David A. Berry and E. R. Mueller. *Official Digest*, v. 32, March, 1960, pp. 340-350.

Linseed oil containing cobalt, manganese, and lead naphthenate, singly and in combination, were exposed to pure oxygen while under the influence of lights of various colors. Measurements were made of the induction periods and rates of oxidation. It was found that the induction period of the oxidation reaction is influenced greatly by both the color of light and the type of metal used as a drying catalyst. Cobalt, manganese, and lead are active in the order given. Blue light is the most active in every case. It is followed by white light.

The Development of Chromium-Base Heat-Resistant Alloys. J. M. Blocher, Jr., and I. E. Campbell, et al. *WADC Technical Report* 53-470; PB 143650; January, 1954, pp. 170. (LC - mi $7.80, ph $25.80)

Modification of the iodide-decomposition process led to the preparation of Cr containing less than 150 ppm of total impurities. Additions of controlled amounts of impurities were made to determine the compositional factors affecting the room-temperature ductility of Cr. The elements most detrimental were Ni (above 0.2%), and C and S (each in quantities over 0.015%). Fe and Si were not especially harmful up to about 0.2%. Variations in O content from about 60 to 3000 ppm had no effect on the bend ductility.

Recrystallization of Cold Rolled Nickel. W. Bollmann. Paper from *Fourth International Conference on Electron Microscopy, Berlin, September 10-17, 1958*, v. 1, 1960, Springer-Verlag, Berlin.

Describes structural phenomena in the recrystallization of high-purity nickel observed by transmission electron microscopy. Recovery, nucleation, grain growth, secondary recrystallization, and the effects of impurities are discussed.

Research Services and Investigations on Subminiature Multielement Diodes and Bistable Elements for Microtronic Circuits. E. B. Dale, M. Genser, M. W. Aarons, M. Pobereskin, J. E. Gates, W. Allred, and C. S. Peet. *Battelle Memorial Institute*, Columbus, Ohio, August, 1954, pp. 42. PB 115274. (LC - mi $2.50, ph $5.25)

Describes work to develop very compact and highly reliable elements for use in subminiaturized digital computers. The effects of minority-carrier injection during forming and of pulse polarity were examined. There was no evidence of transfer of material through the solid from collector to emitter during forming. It appeared that more material was transferred to germanium by negative pulse on n-type germanium than by any other combination of pulse polarity and conductivity type.

Some Fundamentals to Consider in the Design of Automatic Production Machines. Howard Davis. *News in Engineering at Ohio State University*, v. 32, no. 1, February, 1960, pp. 16 + 3 pages.

The questions of mechanization extent and machine flexibility involve engineering decisions of maximum risk. Satisfactory decisions are best insured by considering economic requirements superimposed above the engineering principles involved.

Progress Relating to Civilian Applications During March, October, November, December 1959. Russell W. Dayton and Clyde R. Tipton, Jr. U. S. Atomic Energy Commission, BMI-1330, April 1, 1959, pp. 92; BMI-1391 (Rev.), November 1, 1959, pp. 100; BMI-1398, December 1, 1959, pp. 110; BMI-1403, January 1, 1960, pp. 102.

Status of work at Battelle on nuclear fuel elements, materials, and components; radioisotope and radiation applications; processing of feed materials; developmental studies for nuclear reactors.

Progress Relating to Civilian Applications During January, February, March, June, July 1957 and January 1960. Russell W. Dayton and Clyde R. Tipton, Jr. BMI-1161, February 1, 1957, pp. 76; BMI-1173, March 1, 1957, pp. 72; BMI-1176, April 1, 1957, pp. 80; BMI-1201, July 1, 1957, pp. 58; BMI-1213, August 1, 1957, pp. 64; BMI-1409, February 1, 1960, pp. 102.

Describes status of work at Battelle on development of reactor components, nuclear fuels, radioisotopes, and materials of interest in atomic research.

Metallurgical Studies of Niobium-Uranium Alloys. John A. DeMastry, Frederic R. Shober, and Ronald F. Dickerson. U. S. Atomic Energy Commisison, BMI-1400, December 7, 1959, pp. 42. (OTS $1.25)

In a continuing program, fabrication characteristics, physical and mechanical properties, and corrosion behavior in air, CO_2, NaK, water, and stream were studied for binary niobium fuel alloy containing 10, 20, 30, 40, 50, and 60 w/o uranium. The impurity combinations employed wer 600 ppm oxygn and 0.74 w/o zirconium, 700 ppm oxygen and 0.17 w/o zirconium, and 300 ppm oxygen and 0.02 w/o zirconium. Specimens of these alloys retained their hardness up to 900 C. The impurity combinations employed in the base niobium appeared to have no effect on the corrosion behavior and mechanical properties of the alloys.

The Effect of Impurities on Iron-Chromium-Yttrium Alloys. Roy W. Endebrock, Walston Chubb, Ellis L. Foster, and Ronald F. Dickerson. U. S. Atomic Energy Commission, BMI-1338, April 27, 1959, pp. 14. (OTS - $.50)

A study was made of the effects of carbon, manganese, oxygen, palladium and sulfur on the structure and fabricability of iron-35 w/o chromium-1 w/o yttrium alloy. During melting at 2900 to 3000 F under controlled conditions, the amount of yttrium present in the charge was reduced roughly 50 per cent by reaction with the alumina crucible. Sulfide, added as FeS, and oxide additions also lowered the amount of yttrium retained in ingots. The maximum amount of sulfur retained in an alloy of nominal composition iron-35 w/o chromium-1 w/o yttrium-500 ppm sulfur was found to be about 80 ppm, and an alloy containing this amount of sulfur seemed to show slightly improved fabrication characteristics. None of the impurities investigated affected the fabrication characteristics or the quality of the finished product sufficiently to be considered detrimental from this point of view.

Experimental and Theoretical Studies of the Solidification of Uranium Castings. Ellis L. Foster, Jr., Billie L. Fletcher, Charles K. Franklin, Andrew Lechler, and Ronald F. Dickerson. U. S. Atomic Energy Commission, BMI-1390, October 28, 1959, pp. 52. (OTS $1.75)

Factors affecting the soundness of large cylindrical uranium ingots cast in graphite molds were studied by means of a mathematical model that describes the heat flow during solidification. An experimental technique to accurately measure the temperature at various locations within the solidifying ingot was also developed. This technique involved the use of Ceramo-type, platinum-platinum rhodium thermocouples shielded by small graphite tubes. Variations in pour time, superheat, mold preheat, and outer-mold-wall emissivity were examined by the mathematical model.

Heat Storage for Residential Heat Pumps: A State-of-The-Art Study. J. A. Eibling, D. W. Locklin, and J. W. Droege. Conference Paper No. CP 60-317, presented at the *AIEE Winter General Meeting*, New York, New York, January 31, to February 5, 1960, pp. 17.

Discusses application of heat storage to residential heat pumps, with emphasis on the methods of heat storage that appear to offer promise for further development. In some localities, comfort cooling units have been installed in such large numbers that the peak electric load occurs in the summer. Under such circumstances, cold storage, the heat of fusion of water is probably the best available storage means.

The Development of Oscillatory Plain Bearings and Lubricants for Airframe Applications in the Temperature Range —90 F to 1500 F. W. A. Glaeser, C. M. Allen, et al. *WADC Technical Report*, 59-179; PB 161051; April, 1959, pp. 62, (OTS–$1.75)

Materials and lubricants for high-temperature airframe journal-type bearings were developed and evaluated under simulated operating conditions. Bearing operation was oscillatory at about 15 cycles per minute. Promising shaft and bushing materials were found for temperatures up to 1500 F. A high-temperature lubricant was developed which showed promise in the 800 F to 1200 F range at bearing loads up to 25,000 psi.

Dendritic Inclusions in AlSb Grown-Junction Diodes. H. C. Gorton. *Electrochemical Society, Journal*, v. 107, March, 1960, pp. 248-249.

One of the causes for anomalies, found in grown-junction diodes of aluminum antimonide, has been the inclusion of impurities in the form of long filaments, which in some cases pass through the junction. The peak inverse voltage of grown-junction AlSb diodes generally has been consistent with values expected for material of a given carrier concentration, and general uniformity has been observed in the electrical properties of different diodes cut from the same ingot. In several AlSb crystals, p-n junctions were grown by adding Te or Se to the melt after pulling had commenced.

Properties of Solid Oxides. C. G. Harman, L. D. Loch, and C. R. Austin. *NEPA*-808; PB 143943; June 1948, pp. 258. (LC - mi $11.10, ph $42.60)

A survey was made of the properties of all known solid oxides which are described in the literature; the assembled information is presented for ready reference to facilitate the progress of the NEPA program. Particular attention was directed toward presentation of the information in a systematic and useful form.

Research Studies on the Cooling and Cleaning of Exhaust Gases Containing Boron Combustion Products. G. M. Hein, A. R. Orban, and R. B. Engdahl. *AEDC-TR*-58-9; PB 138609; July 1958, pp. 71. (LC - mi $4.50, ph $12.50)

All possible methods which might be practicable for the removal of boron oxide particles from high-temperature exhaust gases were considered. A literature survey led to the conclusion that wet scrubbers would be most adaptable for this application.

Titanium Alloys for High-Temperature Use Strengthened By Fibers or Dispersed Particles. J. W. Holladay. *DMIC Report* 117; PB 151073; August, 1959, pp. 79. (OTS–$2.00)

Available data are reviewed on heterogeneous structures of titanium in which the titanium matrix is reinforced by a dispersion of metal fibers or particles. Fiber reinforcement offers promise for improving the short time strength and modulus of elasticity in the temperature range of 1000 to 1400 F. It has been demonstrated that titanium can be strengthened by dispersion hardening and by fiber reinforcement, although the best conditions have not yet been fully established.

A Study of the Gamble Diffusion Test. John H. Holzaepfel, Roy W. Greenlee, Robert E. Wyant, and Warren E. Ellis, Jr. *Fertility and Sterility*, v. 10, no. 4, July-August, 1959, pp. 397-402.

An attempt was made to determine whether diffusion rather than convection accounted for the penetration of spermicide into semen. The authors conclude that the Gamble test may be considered a diffusion test for all practical purposes. Because of its simplicity, the test was used to study the effects of various factors on the spermicidal time of jellies. A second aspect of the study concerned the effect of added salts in decreasing the specimicidal time. The decreasing order of effectiveness for the various salts tested was $KCl > MgSO_4 > NaCl > Na_2SO_4 > CaCl_2$.

Elements That Go Into the Adhesives Research Picture. R. M. Kell and C. W. Cooper. *Adhesives Age*, v. 2, no. 12, December, 1959, pp. 20-24.

Outlines a systematic approach which has been shown to be very effective in solving adhesive problems, particularly those involving product development or process improvement.

Phthalocyanines as High-Temperature Lubricants. H. H. Krause, S. L. Cosgrove, and C. M. Allen. *American Chemical Society, Division of Petroleum Chemistry, Symposia, Preprints*, v. 5, no. 2, April, 1960, pp. B105-B119.

Metal-free phthalocyanine is efficient as a lubricant in the temperature range of 800 to 1350 F. Though the precise mechanisms of lubrication with phthalocyanines are not known at this time, it is believed that the lubrication processes are similar to those which occur with other planar structure solid lubricants, and that strongly adherent and protective lubricating films are formed by the chelation of metal-free phthalocyanine with metal substrates.

Plastics. E. L. Kropa and E. E. McSweeney. *Industrial and Engineering Chemistry*, v. 52, January, 1960, 42A-45A.

Reviews 1959 developments in polyoxymethylene, vinyl plastics, fluorocarbons, polypropylene, alkyds, nylon, silicones, and high temperature applications.

The Physics of Adhesion of Solid Bodies. H. Krupp, G. Sandstede, and K.-H. Schramm. (*In German.*) Zur Physik des Haftens fester Körper. *Chemie-Ingenieur-Technik*, v. 32, February, 1960, pp. 99-105.

The nature of dispersion forces as one of the main causes of adhesion processes is explained and using a very simple model the magnitude of the adhesion forces is estimated. Further, the possibilities for improvement of the model employed are indicated so that the influence of the molecular structure of the boundary surface can be taken into account.

Research on Thermostable Molecules and Polymers. Emil A. Lawton and Donna D. McRitchie. *WADC Technical Report* 57-642; PB 131663; November, 1957, pp. 92. (OTS–$2.25)

The yields of reactions for the preparation of phthalocyanines showed that polybenzotetraazaporphins could best be prepared using either o-phthalonitrile and pyromellitic tetranitrile with metal alkoxides or diiminoisoindoline and tetraiminopyromellitic diimide. Various copper polybenzotetraazaporphins were prepared. Copper phthalocyanine, metal-free phthalocyanine, and polybenzotetraazaporphins are unaffected by exposure to 10^9 rep in a Co-60 source. The conductivity of pressed copper phthalocyanine was about 100 times greater than previously observed for this compound.

Core-Temperature Excursions Following a Piping Failure in the Plutonium Recycle Test Reactor. A. W. Lemmon, Jr., C. A. Alexander, L. E. Hulbert, and R. B. Filbert, Jr. U. S. Atomic Energy Commission, BMI-1356, July 6, 1959, pp. 97. (OTS–$2.50)

An evaluation of the temperature excursion and its possible consequences arising from loss of coolant from the Plutonium Recycle Test Reactor (PRTR) has been made for four different postulated ruptures in the primary heavy water coolant system. As a basis for the evaluation, a series of computations was made. These were based on incremental heat and mass balances for sections of Zircaloy-clad UO_2 and plutonium-aluminum fuel elements. Solutions to each problem defined by the postulated break size and its location were obtained by finite-difference approximations performed by an IBM 653 machine digital computer.

The Physical Metallurgy of Precipitation-Hardenable Stainless Steels. D. C. Ludwigson and A. M. Hall. *DMIC Report* 111; PB151067; April 10, 1959, pp. 70. (OTS–$2.00)

Summarizes present knowledge on the physical metallurgy of precipitation-hardenable stainless steels. The alloys discussed include the martensitic types (Stainless W and 17-4 PH), the semiaustenitic types (17.7PH, PH 15-7 Mo, AM 350, and AM 355), and the austenitic types (A-286 and HNM). The areas of metallurgy common to most or all of these materials are discussed on the basis of (1) classification by composition, (2) austenite conditioning, (3) the martensite reaction, and (4) precipitation hardening. The application of metallurgical principles in the handling, heat treatment, and fabrication of these alloys is also discussed.

Aerodynamic Heating of Iron Meteorites During Entry Into the Atmosphere. Robert E. Maringer and George K. Manning. *WADC Technical Report* 59-164; PB 161008; April, 1959, pp. 113.

Specimens of eight iron meteorites were examined. Four of these contained surface zones of structurally altered material resulting from the heat generated during their flight through the atmosphere. By comparing the structures and hardnesses in these zones with those of artificially heated meteoritic iron specimens, thermal gradients as they existed during flight were reconstructed. From these data, using certain mechanistic and mathematical assumptions, it has been possible to estimate rates of heat flow through the meteorite surface and corresponding rates of ablation occurring during high-velocity flight.

The Photographic Resolving Power as a Function of the Thickness of the Film Layer and the Aperture of the Objective. A. Narath and G. Schimmel. (*In German.*) Das

photographische Auflosungsvermogen als Funktion von Filmschichtdicke und Objektivapertur. *Zeitschrift für wissenschaftliche Photographie, Photophysik und Photochemie*, v. 53, nos. 10-12, 1959, pp. 181-201.

The resolving limit for light of different wavelengths (λ = 366, 435, 546 mμ) was determined with experimental emulsions of different kinds. The resolving power decreases with increasing thickness of the layer for all wavelengths except ultraviolet light. The effect of the photographic emulsion predominates at aperture values between 0.28 and 0.5. It is theoretically shown that the value of "contour sharpness", used by Frieser and the "resolving limit" are directly proportional to each other.

Machining of Cobalt-Containing Alloys. C. T. Olofson and F. R. Morral. *Cobalt*, no. 5, December, 1959, pp. 15-25.

Cobalt is an important ingredient in certain high-speed and hot-working tool steels known as red-hard tool steels. It is also an important component of those materials known as "super alloys", which are used for high-temperature applications, particularly in certain aircraft components. Although commonly so regarded, these alloys are not necessarily difficult to machine if appropriate techniques are used. In general, high-quality machine tools, sharp cutting tools of appropriate designs and materials, low speeds and feeds, a continuous cutting action, and intimate cooling by appropriate cutting fluids are required for successful machining of these materials.

Formability of Titanium and Titanium Alloys. C. T. Olofson. PB 138 764; June 30, 1958, pp. 9. (LC mi. $1.80, ph. $1.80)

Presents data on the work hardening of several titanium alloys in comparison with common metals. Discusses factors adversely affecting forming of titanium sheet materials.

Progress on the Use of Gas-Pressure Bonding for Fabricating Low-Cost Ceramic, Cermet, and Dispersion Fuels. Stan J. Paprocki, editor. U. S. Atomic Energy Commission, BMI-1372, August 25, 1959. (OTS $1.)

Basic properties of several types and grades of commercial UO_2 have been determined. Compacting characteristics of these powders were evaluated. Cold-pressed compacts were simultaneously clad and densified to a maximum density of 99.5 per cent of theoretical. The UO_2 powders that were capable of being pressed to the highest cold-pressed density exhibited the least amount of densification during gas-pressure bonding. A small stainless steel-clad UO_2 flat-plate assembly was pressure-bonded at 2100 F for 3 hr at 10,000 psi. Examination of this assembly indicates that it is feasible to prepare fuel assemblies of this type in a one-step operation by use of the gas pressure-bonding process.

Development of Uranium-Nitride Stainless Steel Dispersion Fuel Elements. Stan J. Paprocki, Donald L. Keller, George W. Cunningham, and Andrew K. Foulds, Jr. U. S. Atomic Energy Commission, BMI-1365, July 31, 1959, pp. 19. (OTS $0.75)

Procedures for the fabrication of stainless steel-clad flat-plate fuel elements having a core of 28 w/o UN dispersed in an iron-18 w/o chromium-14 w/o nickel-2.5 w/o molybdenum matrix were developed. In compatibility studies, UN reacted with nickel alone at 1800 F, but no reaction with nickel was observed when the other matrix components were also present. Minus 200 plus 325-mesh UN dispersed in a minus 325-mesh elemental-powder matrix rolled green with a 30% initial reduction at 2100 F and then annealed three hr at 2300 F produced the best fuel core.

The Design of a Heat Exchanger for Cooling Gases Which Contain Large Quantities of Particulate Material. A. A. Putnam and J. M. Allen. *AEDC-TR*-58-16; PB 143277; October, 1958, pp. 39. LC mi $3, ph $6.30)

This report is one of a group resulting from research on the deposition of particles from a flowing gas stream. The phenomenon of particular concern herein is the deposition of small boron oxide particles onto heat-exchanger elements. The particles, which are extremely small in size, are generated in large concentrations from the combustion of boron-containing, high-energy fuels.

Freeing City Traffic. D. R. Rexworthy and D. W. W. King. *New Scientist*, January 28, 1960, pp. 197-199.

Could electronic computers be used to guide the traffic flow? It is proposed here that such a system could cut delays at intersections, indicate less congested alternative routes and enable road space to be apportioned according to the volume of traffic in each direction.

Progress on the Development of Uranium Carbide-Type Fuels. Frank A. Rough and Walston Chubb, editors. U. S. Atomic Energy Commission, BMI-1370, August 21, 1959, pp. 14. (OTS $0.75)

Uranium monocarbide can be prepared by reacting uranium metal powder with methane at about 650 C. Sintered carbides of greater than 90 per cent of theoretical density can be made. The cast density of carbides varies from 13.56 per cm^3 for UC to 11.7 g per cm^3 for UC_2. The electrical resistivity of cast carbides is about 40 microhm-cm for UC and about 90 microhm-cm for UC_2. Additional studies are in progress.

Irradiation of Uranium Monocarbide. F. A. Rough, A. W. Hare, R. B. Price, and S. Alfant. *Nuclear Science and Engineering*, v. 7, Feb. 1960, pp. 111-121.

Uranium carbide containing about 5.2 w/o C has been irradiated to nominal burnups of 1000 and 5000 Mwd/ton of carbide. The results are generally encouraging, although some cracking has been observed. The observed density decreases were about the same at 1000 and 5000 Mwd/ton irradiations, being 0.7 to 2.5 and 0.6 to 2.5% respectively. The problems and questions raised by these irradiations are discussed.

These Models Preview Stress, Strain. I. Theory of Similitude. II. Building the Better Model. III. The Structural Model at Work. I. Ralph Simon. II. Raymond G. Carlson. III. Charles W. Bert. *Product Engineering*, v. 30, no. 44, October 26, 1959, pp. 55-62.

Discusses design, construction, and use of inexpensive replicas to give quick answers to complex problems that would be difficult to solve with pencil-and-paper methods. Describes materials that have unique properties that make them particularly useful for model design. Gives examples of special loading and measuring methods which may be needed when conventional instruments will not supply the needed information.

From Thermodynamics, Equation for Adiabatic Head Selects Compressor Type. Wilbur A. Spraker and Robert A. Stein. *Product Engineering* (Design Digest Issue), v. 31, no. 10, March 7, 1960, pp. 47-51.

If one knows the pressure ratio, required flow, and shaft speed, the "adiabatic head" concept can lead directly to the choice between a positive-displacement and centrifugal compressor—for all gases. Describes a step-by-step method, including the needed reference data.

The All-Beta Titanium Alloy (Ti-13V-11Cr-3Al). R. A. Wood and H. R. Ogden. PB 151 066; DMIC Report 110; April 17, 1959, pp. 199. (OTS $3.)

Summarizes the information available to the Defense Metals Information Center on the metallurgy, properties, and fabrication of a new type of commercial titanium alloy. It has a body-centered-cubic beta-phase structure in the annealed condition. Because of the great potential of this alloy, it has been added to the Department of Defense Titanium Sheet-Rolling Program. Detailed data on the heat treatment, mechanical properties, welding, and forming of the all-beta alloy are given.

Hydrospark Forming . . . Evolution of the Process. H. J. Wagner and J. G. Dunleavy. *Tool Engineer*, v. 44, no. 3, March, 1960, pp. 83-86.

The electrical spark discharge in liquids appears to be a convenient and powerful method of converting electrical to mechanical energy. The use of the electrohydraulic effect as a metal working tool has certain inherent advantages, such as simplicity, which may make it economically feasible in metal-forming applications. Much as in explosive forming, the energy may be applied to the metal being worked either through a liquid medium or by actuating a ram which forms the metal.

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ABSTRACTS

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ADMINISTRATION AND PHILOSOPHY OF RESEARCH

6190* Interaction and Attitudes Between Scientists and the Auxiliary Staff. II. Viewpoint of Scientists. Based on a government organization for medical research, the author presents data from 338 scientists showing how their attitudes on the adequacy of various auxiliary services are related to the central or divisional source of services, to use of direct or indirect channels, and to use of personal or written contact. The role of the divisional administrative office is examined. Implications for practical problems, such as centralization of services, and for the concept of control in organizations are discussed. ***Donald C. Pelz.*** *Administrative Science Quarterly,* v. 4, no. 4, Mar. 1960, p. 410-425.

6191* The Inertial Gyro—An Example of Basic and Applied Research. The inertial-gyro-unit development described here was and still is in progress at the Instrumentation Laboratory of the Massachusetts Institute of Technology. The primary function of the laboratory is education, with particular attention given to the identification and balanced development of individuals with potentially high creative abilities. The author explains, using the gyro development as an example, that the terms "basic research" and "applied research" can frequently be applied to the same project, and that the definitions depend on the point of view of the worker. ***C. S. Draper.*** *American Scientist,* v. 48, no. 1, Mar. 1960, p. 9-19.

6192* Scientific Research in the University. The author concludes that it is a major responsibility of the university to encourage and sponsor scientific research of the kind that can be called creative scholarship. In fact, it must do this to be truly an institution of higher learning and to serve properly its students, faculty, and the general public. This activity is part of, and inseparable from, adequate teaching on advanced levels. It also enables the university to make its necessary contribution to the preservation and advancement of modern civilization. ***Joseph H. Simons.*** *American Scientist,* v. 48, no. 1, Mar. 1960, p. 80-90.

6193 Research Carries Sales in Buyers' Market. Salesmen supported by a sound company research program get preference from purchasing agents. A solid research program implies the guarantee of a flow of new products, assistance in finding new or improved raw materials, satisfactory technical service and an effort by a supplier to whittle away at his manufacturing costs. *Chemical Week,* v. 86, no. 10, Mar. 5, 1960, p. 53 + 2 pages.

6194 Creativeness for Engineers. A Philosophy and a Practice. In this new edition, the author gives first a philosophy to stimulate and motivate creativeness and then, in the second part of the book, he deals with the creative approach or practice aiming to produce a more effective reaction between the individual and his effort. ***Donald Stuart Pearson.*** 3rd Ed. 150 pp. 1960. Donald S. Pearson, University Park, Pa. (Q175 P31c3)

6195* Management of Research. Deals with the subject under four main headings, namely, the direction, financing, staffing and organization of research. The main conclusion is that, as research is an integral part of modern industry, managerial judgment and business acumen are vital qualites in the management of it. ***George H. Nelson.*** *Engineer,* v. 209, Mar. 11, 1960, p. 432-435.

6196* How to Evaluate Research Output. Management should use methods that will help it to achieve a better understanding of the research department's contributions and to raise the penetrating questions that will keep research managers on their toes and their projects moving effectively along intended lines. ***James Brian Quinn.*** *Harvard Business Review,* v. 38, no. 2, Mar.-Apr. 1960, p. 69-80.

6197 A Stochastic Model for Determining the Size and Allocation of the Research Budget. An analytical method is presented for determining the size of the research budget and allocating it among competing projects. A stochastic model is

*Asterisks mark items that may be used in the Battelle Library only. None of the unbound materials listed are available for interlibrary loan.

utilized. The over-all profit-maximization of the firm is used as a framework. A hypothetical example is given to illustrate the method. ***Raoul J. Freeman.*** *IRE Transactions on Engineering Management*, v. EM-7, no. 1, Mar. 1960, p. 2-7. (TK1 In6.6em Vis.)

6198 Regression Models for Company Expenditures On and Returns From Research and Development. Data were gathered on the research expenditures, sales, and profits of a sample of large firms which had been conducting organized research for 25 years or more. A linear relationship is hypothesized for explaining the size of the research budget. A regression model is developed for expressing the returns on R and D expenditures, with lags up to six years. Suggestions are made for the application and possible uses of the method by an individual firm. ***Ira Horowitz.*** *IRE Transactions on Engineering Management*, v. EM-7, no. 1, Mar. 1960, p. 8-13. (TK1 In6.6em Vis.)

6199 Some Organizational Factors Affecting Creativity. This paper reports on the factors considered important in influencing creativity in a number of research laboratories. The data were gathered through interviews with research directors, administrators, and scientists. Five factors are identified and analyzed. ***Norman Kaplan.*** *IRE Transactions on Engineering Management*, v. EM-7, no. 1, Mar. 1960, p. 24-30. (TK1 In6.6em Vis.)

6200 On the Anatomy of Development Projects. The structure of an R & D project is described in terms of an Effort-Distribution Array. A logistic model is presented for the cumulative times series of effort devoted to a project, and problems of using such curves for prediction are discussed. ***P. V. Norden.*** *IRE Transactions on Engineering Management*, v. EM-7, no. 1, Mar. 1960, p. 34-42. (TK1 In6.6em Vis.)

6201* Sponsored Research—Good or Bad? The author believes research is an essential activity for any department of an engineering school. Without research, the department becomes stagnant and pedantic. Only that research appropriate for a university should be done, regardless of the availability of funds for other work. ***Ralph A. Morgen.*** *Journal of Engineering Education*, v. 50, no. 7, Mar. 1960, p. 565-568.

6202* Faculty Compensation for Sponsored Research: Good or Bad? There has been an increasing participation by educational institutions in government-sponsored and industry-sponsored research projects. There are especially wide divergencies in policies as regards extra compensation for academic staff members who direct or conduct sponsored research. It is with this subject that this paper is concerned. ***W. A. Koehler.*** *Journal of Engineering Education*, v. 50, no. 7, Mar. 1960, p. 569-571.

6203 Planning in Science. Summarizes the findings of an international symposium sponsored by the Czecho-Slovak Union of Scientific Workers, Sept. 19-22, 1959, in Prague. ***Ivan Malek.*** *Nature*, v. 185, Mar. 12, 1960, p. 738-739.

AERONAUTICAL AND ASTRONAUTICAL ENGINEERING

6204 A Note on the Drag Due to Lift as Influenced by a Jet Flap on a Wing of Finite Span. The classical theory for thin and lightly loaded wings in subsonic flow is extended by taking into consideration the interaction between the jet and the trailing vortices. It is shown that the minimum induced drag, for given lift, span, and jet thrust, is reduced by a jet flap, the reduction corresponding to an increment of $2C_J/\pi$ to the aspect ratio (C_J = jet coefficient, referred to free-stream dynamic pressure and wing area). ***Sune B. Berndt.*** *Aeronautical Research Institute of Sweden, Report No.* 85, 1959, 10 pp. (TL504 F67m Vis.)

6205 Propeller Effects on the Stability and Control of VTOL Aircraft. An experimental investigation of forces and moments acting on a propeller was conducted over a range of tilt angles from 0° to 90°. It was found that the normal force and pitching moment acting at the propeller hub are of considerable magnitude and must not be neglected in any analysis of VTOL-STOL aircraft which must incline the propeller over 15° for take-off and landing. Thrust variation with forward velocity and pitch angle is another factor which must be considered in any analysis of tilt-wing or tiltable propeller aircraft configurations. ***Henry E. Payne, III.*** *Aero/Space Engineering*, v. 19, Mar. 1960, p. 48-52.

6206 How Aircraft Designers Look at Light Metal Castings. Light-metal castings could be used in modern aircraft design more than they are at the present time if they can be developed to the point where they meet strength requirements of 60 ksi ultimate strength, 50 ksi yield strength and 5% elongation. The problems with various light-metal alloys in the manufacture of aircraft are considered. ***Albert R. Mead.*** *American Foundrymen's Society, Transactions*, v. 67, 1959, p. 137-142. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6207 Effect of Thermocouple Cavity on Heat Sink Temperature. An analysis is made of problems associated with prediction and correction of temperature disturbances created by thermocouples placed beneath a surface of a heat sink (or calorimeter) exposed to heat flux during re-entry of a space vehicle. ***James V. Beck and H. Hurwicz.*** *ASME, Transactions, Series C, Journal of Heat Transfer*, v. 82, no. 1, Feb. 1960, p. 27-36.

6208 Laminar Transfer From Isothermal Spanwise Strips on a Flat Plate. The Rubesin-Klein-Tribus method is used to calculate rates of heat transfer by forced convection from two isothermal spanwise strips in tandem. The general results are applicable to either laminar or turbulent flow. ***H. H. Sogin.*** *ASME, Transactions, Series C, Journal of Heat Transfer*, v. 82, no. 1, Feb. 1960, p. 53-63.

6209* A Rocket Borne Video Telescope for Observing Mars. Suggests use of a Cassegrainian telescope in conjunction with a modified image orthicon pickup tube. By using a 12-in. aperture with an *f*-number of 31.7 and an aspect ratio of 0.10 on the camera tube, a picture covering a field of 26.3 x 263 n.mi. is obtainable when the vehicle is 10^5 n.mi. from Mars. Details as small as one n.mi should be resolvable at the center of the image. By using 10 watts of radio frequency power at 2500 mc, a picture could be transmitted over the distance of 10^5 n.mi. in about 3.3 minutes. The corresponding bandwidth is 66 cps. ***D. H. Robey.*** *Astronautica Acta*, v. 5, no. 6, 1959, p. 313-327.

6210* On Mid-Course Guidance in Satellite Interception. Describes technique for the systematic process of measurement, computation, and control required to assure that a vehicle achieves a desired position in space-time. ***George W. Morgenthaler.*** *Astronautica Acta*, v. 5, no. 6, 1959, p. 328-346.

6211* A Unified Analytical Description of Satellite Attitude Motions. Previous formulations of the equations of satellite attitude motion and the perturbation torques on the satellite are unified and generalized. Equations of motion are developed in terms of arbitrarily large attitude deviation angles relative to an arbitrary attitude reference frame. Explicit expressions are obtained for effective external and parametric excitation torques from internal moving parts, inertial reaction control parts, and the motion of the attitude reference frame. ***Robert E. Roberson.*** *Astronautica Acta*, v. 5, no. 6, 1959, p. 347-355.

6212* Some Aspects of a Three-Body Problem. Treats the motion of a particle in the field of two non-rotating mass centers whose separation remains fixed. The theory may be applied to discuss the motion of a satellite near a planet which has a large bulge or "bump". ***G. K. Oertel and S. F. Singer.*** *Astronautica Acta*, v. 5, no. 6, 1959, p. 356-366.

6213* On the Flight Path of a Hypervelocity Glider Boosted by Rockets. Investigates the flight of a hypervelocity vehicle operating along a so-called equilibrium trajectory, that is, a trajectory such that the weight is balanced by the lift plus the centrifugal force due to the curvature of the Earth. It is shown that the path which maximizes the range includes an initial sub-arc in which all the propellant mass is expended at the maximum burning rate of the engine, and a final sub-arc in which the hypervelocity glider coasts at variable altitude and in such a way that, for each instantaneous velocity, the aerodynamic drag is a minimum. ***Angelo Miele.*** *Astronautica Acta*, v. 5, no. 6, 1959, p. 367-379.

6214 Hypersonic Aerodynamics. Two- and three-dimensional flow; minimum-drag bodies; hypersonic small-disturbance theory; slender body theory; hypersonic flow over blunt bodies; stability and control. ***Robert Wesley Truitt.*** 462 pp. 1959. Ronald Press, New York. (TL571.5 T77h)

6215 Viscous Aerodynamic Characteristics in Hypersonic Rarefied Gas Flow. Considers the problem of calculating viscous aerodynamic characteristics of blunt bodies at hypersonic speeds and at sufficiently high altitudes where the appropriate mean free path becomes too large for the use of familiar boundary-layer theory but not so large that free molecule concepts apply. Results of an order-of-magnitude analysis are presented to define the regimes of rarefied gas flow and the limits of continuum theory. ***Ronald F. Probstein and Nelson H. Kemp.*** *Journal of the Aero/Space Sciences,* v. 27, Mar. 1960, p. 174-192.

6216 A Study of Vortex Cancellation. The cancellation of a vortex by means of another concentric vortex of equal strength but opposite spin is investigated. When such a cancellation occurs, there is a recovery of static pressure. The vortices are generated by means of two three-dimensional airfoils cantilevered from the duct wall, one being situated in the wake of the other. The airfoils have opposite effective angles of attack and therefore have trailing vortices of opposite spin, as required. It is demonstrated experimentally that there exists an optimum angle of attack for the second airfoil which cancels the vortex from the first airfoil and restores uniform flow downstream of the two airfoils. ***Allan Schaffer.*** *Journal of the Aero/Space Sciences,* v. 27, Mar. 1960, p. 193-196.

6217 Design and Cost Considerations for High-Altitude Aircraft Systems. The significant factors involved in the design of aircraft for high altitude flight are discussed within the context of a patrol or endurance application. Because of this mission constraint, only subsonic aircraft configurations with non-afterburning turbojet engines are considered. Some of the design limitations imposed by the present state-of-art are explored. The incremental cost of high altitude flight is indicated and the interaction between cost and possible operational requirements is briefly investigated. Some of the possible areas for future improvement in altitude performance are delineated. ***T. F. Cartaino.*** *Rand Corporation, Report P-*1655, Mar. 10, 1959, 19 pp. (T13 R15r Contin.)

See also: **6869** (titanium airframes); **6870** (steel in airframes).

AGRICULTURE

6218* Drying Rate of Alfalfa Hay. ***T. T. Pedersen and W. F. Buchele.*** *Agricultural Engineering,* v. 41, Feb. 1960, p. 86 + 5 pages.

6219* An Insect Host-Parasite Population. Eight populations *Trialeurodes vaporariorum* and *Encarsia formosa* were propagated on tomato plants in the greenhouse for about eight months. The general trend in each experiment was one of fluctuations of slightly, but distinctly, increasing amplitude. ***Thomas Burnett.*** *Canadian Journal of Zoology,* v. 38, no. 1, Feb. 1960, p. 57-75.

6220* Population Processes in the Vole and Their Relevance to General Theory. The hypothesis is set up that all species are capable of regulating their own population densities without destroying the renewable resources of their environment, or requiring enemies or bad weather to keep them from doing so. The existence of such a mechanism would not imply that it is always efficient, especially in situations to which a species is not adapted, or that species do not also occur in environments where the mechanism seldom, if ever, comes into effect. The hypothesis states that, under appropriate circumstances, indefinite increase in population density is prevented through a deterioration in the quality of the population. The effects of independent events, such as weather, become more severe as numbers rise and quality falls. ***Dennis Chitty.*** *Canadian Journal of Zoology,* v. 38, no. 1, Feb. 1960, p. 99-113.

6221 Mechanisms of Insect Resistance to the Chlorohydrocarbon Insecticides. Discusses differences between susceptible and resistant houseflies as regards penetration and metabolism of the insecticide. ***F. R. Bradbury and H. Standen.*** *Journal of the Science of Food and Agriculture,* v. 11, Feb. 1960, p. 92-100.

6222* Agriculture in the 1960s. Discusses current trends in agricultural research and predicts some of the advances which may be expected during the next decade. ***William Slater.*** *New Scientist,* v. 7, Jan. 28, 1960, p. 194-196.

6223 Physiology of Insect Development. A portion of the proceedings of the "Developmental Biology Conference Series of 1956". ***Frank L. Campbell, editor.*** 167 pp. 1959. The University of Chicago Press, Chicago. (QL461 C76p)

6224 Oklahoma Conference—Radioisotopes in Agriculture. Sponsored by Associated Midwest Universities and Argonne National Laboratory. Held April, 1959, at Oklahoma State University, Stillwater, Oklahoma. *U. S. Atomic Energy Commission, TID-*7578, Apr. 1959, 287 pp. (UF767 Un3ti Contin.)

BIOCHEMISTRY AND BIOPHYSICS

6225 Poison Control Activities in the United States. ***Henry L. Verhulst and Howard M. Cann.*** *American Pharmaceutical Association, Journal (Practical Pharmacy Ed.),* v. 21, Mar. 1960, p. 122-125.

6226* Effect of Stress on Toxicity and Tumor Growth Inhibition of Neomycin. Pure preparations of neomycin B did not reproduce the syndrome characterized by nephrocalcinosis, cardiac necrosis, and tumor inhibition which has been produced by less pure mixtures of neomycin containing B and C. If in addition to pure neomycin preparation, certain stressor agents are applied, toxicity as well as tumor-inhibiting effects can be constantly reproduced. ***Serge Renaud.*** *Antibiotics & Chemotherapy,* v. 10, Feb. 1960, p. 109-113.

6227* Structure-Activity Relationships in a Series of Synthetic Penicillins. ***A. Gourevitch, G. A. Hunt, and J. Lein.*** *Antibiotics & Chemotherapy,* v. 10, Feb. 1960, p. 121-128.

6228* Changes in the Cellular Content of Ribonucleic Acid, Deoxyribonucleic Acid and Protein in Cultured Cells During Logarithmic Growth. These constituents approximately double in quantity in the lag phase. DNA accumulates most rapidly, and the maximum level remains essentially constant for several hours before cell division, suggesting synthesis during mitotic interphase. ***M. N. Swaffield and G. F. Foley.*** *Archives of Biochemistry and Biophysics,* v. 86, no. 2, Feb. 1960, p. 219-224.

6229* Chromatography of Infectious Ribonucleic Acid on Calcium Phosphate Columns. ***Alberto D. Vizoso and Alfred T. H. Burness.*** *Biochemical and Biophysical Research Communications,* v. 2, no. 2, Feb. 1960, p. 102-106.

6230* Inhibition of Growth of Cultured Mammalian Cells by Liver Extracts. The inhibitory effect of liver preparations appears to result from their content of arginase which depletes the medium of an amino acid essential for growth. The results suggest that caution should be used in interpreting the results of growth-inhibitor experiments involving the injection of organ extracts into animals. ***Irving Lieberman and Peter Ove.*** *Biochimica et Biophysica Acta,* v. 38, no. 1, Feb. 12, 1960, p. 153.

6231* A Fine-Structure Genetic and Chemical Study of the Enzyme Alkaline Phosphatase of *E. Coli.* I. Purification and Characterization of Alkaline Phosphatase. Discusses the development of a system with which it will be possible to do fine-structure genetic analysis of mutations affecting a single enzyme, and at the same time to identify chemical alterations in the enzyme molecule resulting from the mutations. Describes the methods that have been developed for purifying alkaline phosphatase from *E. coli,* and also some physical-chemical properties of the purified material. ***A. Garen and C.***

Levinthal. *Biochimica et Biophysica Acta*, v. 38, no. 3, Mar. 11, 1960, p. 470-483.

6232* Leukemia in Hiroshima Atomic Bomb Survivors. ***Robert Heyssel, et al.*** *Blood*, v. 15, Mar. 1960, p. 313-331.

6233* Conservation of Fungous Cultures. Methods of conservation of fungous cultures have been classified under the general headings of periodic transfer, oil-covered slants, soil or sand cultures, drying, freezing and freeze-drying. Extensive bibliography. ***Dorothy I. Fennell.*** *Botanical Review*, v. 26, no. 1, Jan.-Mar. 1960, p. 79-141.

6234* A Human Skin Culture Technique Used for Cytological Examinations . . . of human chromosomes. ***D. G. Harnden.*** *British Journal of Experimental Pathology*, v. 41, no. 1, Feb. 1960, p. 31-37.

6235* Antibody Production by Single Cells. IV. Further Studies on Multiply Immunized Animals. Cells from rats immunized with mixtures of 2 *Salmonella* flagellar antigens were tested for antibody production. Of these, 125 produced one or other antibody but none produced both. A further 351 cells from rats immunized with 3 antigens contained 104 single producers, but no double or triple producers. When rats were serially immunized with 2 antigens, similar phenotypic restriction of antibody-producing capacity was observed amongst 154 cells removed some weeks later. ***G. J. V. Nossal.*** *British Journal of Experimental Pathology*, v. 41, no. 1, Feb. 1960, p. 89-96.

6236* Symposium on the Biological Effects of Radiation. Sponsored by the Canadian Federation of Biological Societies at the University of Toronto, in June, 1959. ***E. A. Sellers, editor.*** *Canadian Journal of Biochemistry and Physiology*, v. 38, Mar. 1960, p. 311-338.

6237* Nuclear Behavior of Blood Cells. ***Vibeke E. Engelbert.*** *Canadian Journal of Zoology*, v. 38, no. 1, Feb. 1960, p. 189-198 + 7 plates.

6238* Chromosome Aberrations in Irradiated Cells of Chinese Hamster Grown in Tissue Culture. The aberrations included: chromatid breaks, incomplete breaks, isolocus breaks, various types of chromatid interchanges, chromatid intrachanges, minutes, and rings. The aberrations encountered after irradiation were of the chromatid type. The lowest dose used was 15 rads and it caused abnormalities. ***Resa Wakonig and D. K. Ford.*** *Canadian Journal of Zoology*, v. 38, no. 1, Feb. 1960, p. 203-207 + 3 plates.

6239* Standardized Nomenclature for Inbred Strains of Mice: Second Listing. Prepared by the committee on standardized genetic nomenclature for mice. ***G. D. Snell, et al.*** *Cancer Research*, v. 20, no. 2, Feb. 1960, p. 145-169.

6240* Factors Determining the Transformation of a Culture of Organs in a Tissue Culture. The food supply being the same, explants of embryonic organs produce either histiotypical cultures or organotypical cultures, according to the substrate with which they are in contact. In the case of a histiotypical evolution, the spreading of the cells varies according to the medium. *(In French.)* Sur les facteurs qui déterminent la transformation d'une culture d'organes en culture de tissus. ***Étienne Wolff and Léa Marin.*** *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, v. 250, no. 3, Jan. 18, 1960, p. 609-611.

6241* Electron Microscope Study of Provoked Cellular Lesions. Virus Echo 10 or Reovirus was studied under the electron microscope while being developed in KB cells. In the cytoplasmic inclusion bodies, particles made of a 35 mμ body, surrounded by a membrane 70 mμ in diameter, was found. The particles were dispersed or arranged in crystalloid groups. Their dimensions were the same as those attributed to the virus by ultrafiltration. *(In French.)* Étude au microscope électronique des lésions cellulaires provoquées. ***Paul Tournier and Michel Plissier.*** *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, v. 250, no. 3, Jan. 18, 1960, p. 630-632.

6242* Differential Gene Response to Mutagens in *Drosophila melanogaster*. O. G. Fahmy and Myrtle J. Fahmy. *Genetics*, v. 44, no. 6, Nov. 1959, p. 1149-1171.

6243 Heredity and Evolution in Human Populations. L. C. Dunn. No. 1. 157 pp. 1959. Harvard University Press, Cambridge, Massachusetts. (QH431 D92h)

6244 International Textbook of Allergy. J. M. Jamar, editor. 639 pp. 1959. Charles C. Thomas, Springfield, Illinois. (RC584 J22i)

6245 Blood Flowmeters Symposium. . . . held at the University of Nebraska College of Medicine, Omaha, Nebraska, June 17-19, 1959. *IRE Transactions on Medical Electronics*, v. ME-6, no. 4, Dec. 1959, p. 193-304. (TK1 In6.6m Vis.)

6246 A Unified Concept of Health and Disease. Considers the practical question of how we know that someone is sick. ***George L. Engel.*** *IRE Transactions on Medical Electronics*, v. ME-7, no. 1, Jan. 1960, p. 48-57. (TK1 In6.6m Vis.)

6247* Method of Finding the "Arteriosclerogenic Substance" and Producing Intimal Arteriosclerosis on Various Species of Animals. ***Takio Shimamoto, et al.*** *Japan Academy, Proceedings*, v. 35, no. 10, Dec. 1959, p. 632-637.

6248* Inhibition of Nucleic Acid Synthesis by Chloramphenicol in Synchronized Cultures of *Escherichia coli*. C. O. Doudney. *Journal of Bacteriology*, v. 79, no. 1, Jan. 1960, p. 122-124.

6249* Continuous Antibiotic Fermentation—Design of a 20 Litre, Single-Stage Pilot Plant and Trials With Two Contrasting Processes. Both the chloramphenicol and penicillin processes appeared adaptable to such an operation. At dilution rates of 1.0 and 0.5 volume changes per day respectively, yields of from ¼ to ½ of the maxima obtained in batch operation were maintained in the steady-state for more than two weeks. ***M. C. Bartlett and Philipp Gerhardt.*** *Journal of Biochemical and Microbiological Technology and Engineering*, v. 1, no. 4, Dec. 1959, p. 359-377.

6250* Continuous Streptomycin Fermentation. The system was maintained for 300-400 h with yields amounting to 2000-2500 u. of streptomycin/ml without any signs of contamination or degeneration of the growing culture. ***Bohumil Sikyta, Jiří Doskočil, and Jitka Kašparová.*** *Journal of Biochemical and Microbiological Technology and Engineering*, v. 1, no. 4, Dec. 1959, p. 379-392.

6251* Fermentation Process Kinetics. Effects of operating variables on the primary kinetic processes, growth, sugar utilization and antibiotic formation, in the penicillin process, illustrate the special nature of this type. ***Elmer L. Gaden, Jr.*** *Journal of Biochemical and Microbiological Technology and Engineering*, v. 1, no. 4, Dec. 1959, p. 413-429.

6252* Transient and Steady States in Continuous Fermentation. Theory and Experiment. ***Robert Luedeking and Edgar L. Piret.*** *Journal of Biochemical and Microbiological Technology and Engineering*, v. 1, no. 4, Dec. 1959, p. 431-459.

6253* On the Role of Ribonucleic Acid in Animal Virus Synthesis. I. Studies With 5,6-Dichloro-1-β-d-ribofuranosylbenzimidazole. ***Igor Tamm, Marjorie M. Nemes, and Suydam Osterhout.*** *Journal of Experimental Medicine*, v. 111, Mar. 1960, p. 339-349.

6254* On the Role of Ribonucleic Acid in Animal Virus Synthesis. II. Studies With Ribonuclease. Ribonuclease is a highly active inhibitor of vaccinia virus multiplication *in vitro* and of pock formation by vaccinia and herpes simplex viruses on the chorioallantoic membrane *in vivo*. RNase caused no inactivation of the infectivity of vaccinia and herpes simplex virus particles but it had a marked inhibitory effect on multiplication of these viruses when administered many hours after infection of host cells had occurred. The results obtained indicate that ribonucleic acid is necessary for the multiplication of two DNA-containing viruses; *i.e.*, vaccinia and herpes simplex. ***Igor Tamm and Rostom Bablanian.*** *Journal of Experimental Medicine*, v. 111, Mar. 1960, p. 351-368.

6255* Genetic Studies of Influenza Viruses. I. Viral Morphology and Growth Capacity as Exchangeable Genetic Traits. Rapid in Ovo Adaptation of Early Passage Asian Strain Isolates by Combination with PR8. ***Edwin D. Kil-***

bourne and James S. Murphy. *Journal of Experimental Medicine*, v. 111, Mar. 1960, p. 387-407 + 4 plates.

6256* Toxic Marrow Failure Treated by a Homograft of Foetal Haemopoietic Tissue. The transplanted hemopoietic tissue matured and survived in the patient for a time. Its rejection was followed by restoration of normal marrow function in the host. ***J. B. Bridges, J. M. Bridges, G. J. A. Edelstyn, A. R. Lyons, and M. G. Nelson.*** *Lancet*, no. 7125, Mar. 19, 1960, p. 629-632.

6257* Medical Discoveries—Who and When. A dictionary listing thousands of medical and related scientific discoveries in alphabetical order, giving in each case the name of the discoverer, his profession, nationality, and the date of the discovery. ***J. E. Schmidt.*** 555 pp. 1959. Charles C. Thomas, Springfield, Illinois. (R121 Sch54m Ref.)

6258* Symposium on Hereditary Metabolic Diseases. I. *George M. Guest, editor.* *Metabolism*, v. 9, no. 3, Mar. 1960, p. 193-292.

6259* The Gene and Cell Differentiation. Nuclei and chromosomes are chemically and visibly different in different cells of the body. These differences may be indicative of differential activity, most clearly indicated by interactions between adjacent segments of a chromosome, one controlling the activity of the other, so that a given gene's action is expressed in some cells, not in others. ***T. M. Sonneborn.*** *National Academy of Sciences, Proceedings*, v. 46, Feb. 1960, p. 149-165.

6260* Studies on S—RNA Synthesis. I. Purification and General Characteristics of the RNA-Enzyme Complex. *E. S. Canellakis and Edward Herbert.* *National Academy of Sciences, Proceedings*, v. 46, Feb. 1960, p. 170-178.

6261* The Effect of Posttreatment With Chloramphenicol on Various Ultraviolet-Induced Mutations in *Escherichia coli.* The yield of mutations from *lac*$^-$ to *lac*$^+$ was markedly and irreversibly reduced by the post-treatment, but there was no appreciable effect on mutations to *str-r* and *str-i*. Two distinct pathways of mutagenesis initiated by ultraviolet light are inferred. ***Evelyn M. Witkin and Elizabeth C. Theil.*** *National Academy of Sciences, Proceedings*, v. 46, Feb. 1960, p. 226-231.

6262 Effect of Nitrous Acid on Tobacco Mosaic Virus: Mutation or Selection? Questions the interpretation of effects as due to mutation. ***F. C. Bawden.*** *Nature*, v. 184, Sept. 5, 1959, p. 27-29.

6263 Effect of Cytotoxic Agents on Antibody Production. Cytotoxic agents which strongly inhibit nucleic acid synthesis, and particularly synthesis of deoxyribonucleic acid, have much less effect on protein synthesis. These observations lead to belief that the induction phase of antibody production is concerned with antigen-induced changes in nucleic acid metabolism. No compound ineffective against tumors caused significant impairment of antibody-production under the conditions of this experiment, although most of them were tested almost to the limit of tolerance. ***M. C. Berenbaum.*** *Nature*, v. 185, Jan. 16, 1960, p. 167-168.

6264 Activity of a Substance Extracted From the Fermentation Products of *Acetobacter aceti* on Ehrlich's Ascites Tumour Cells. A substance possessing interesting biological activities and with some well-defined chemical characteristics has recently been isolated from vinegar. It markedly inhibited the growth of human tumor cells cultivated *in vitro*. Treated mice showed nearly complete inhibition of tumor growth and very marked decrease of number of cells per ml. of ascitic fluid. ***G. A. Lanzani and A. Pecile.*** *Nature*, v. 185, Jan. 16, 1960, p. 175-176.

6265 Anti-Tumour Activities of Copper Chelates. α-Ketoglutaric acid oxime was found to form its Cu, Fe, or Ni chelate at the physiological *p*H, and its antitumor activity *in vitro* was observed by the stained cell count method. The oxime (3-6 mgm./kgm./day), exhibited potential antitumor activities on Ehrlich carcinoma and Crocker sarcoma 180 in the presence of Cu, and not in the co-existence of other metal ions, such as Ni, Co, Zn, Fe, Mn, Mg, and Hg. ***Kazuhiko Takamiya.*** *Nature*, v. 185, Jan. 16, 1960, p. 190-191.

6266 Antibodies in Ribonucleoproteins. Results indicate that the process of antibody response involves a marked increase in the ribonucleoprotein content of the antibody-forming organ, and that the protein moiety of this ribonucleoprotein contains antibodies which are released in an active form upon the destruction of the ribonucleic acid moiety. ***M. Feldman, D. Elson, and A. Globerson.*** *Nature*, v. 185, Jan. 30, 1960, p. 317-319.

6267 Action of Antibodies and Plasmin on Ehrlich Ascites Tumour Cells. *I. Ginsburg and M. Ram.* *Nature*, v. 185, Jan. 30, 1960, p. 328-330.

6268 Effect of Nitroacridine 3663 on Synthesis of Deoxyribonucleic Acid and Multiplication of T_2 Phage. At very low concentrations (0.05-0.15 μ gm./ml.) it inhibits the synthesis of T_2 phage without inhibiting the multiplication of the host cell. At higher concentrations the compound inhibits the synthesis of phage deoxyribonucleic acid as well as the multiplication of *E. coli* B. ***G. Dénes and L. Polgár.*** *Nature*, v. 185, Feb. 6, 1960, p. 386.

6269 Mutagenic Action of Mitomycin C on *Escherichia coli.* Mitomycin C affects the genetic mechanism, exerting a mutagenic action and stimulating the recombination rate in *Escherichia coli*. ***Teiji Iijima and Atsuyoshi Hagiwara.*** *Nature*, v. 185, Feb. 6, 1960, p. 395-396.

6270 In Vitro Synthesis of Foetal and Adult Haemoglobin by Foetal Haematopoietic Tissues. Relatively more hemoglobin *F* was produced by cells from liver and spleen than from bone marrow, but the fetal bone marrow produced twice as much hemoglobin *F* as hemoglobin *A*. ***E. Donnall Thomas, Harry L. Lochte, Jr., William B. Greenough, III, and Marion Wales.*** *Nature*, v. 185, Feb. 6, 1960, p. 396-397.

6271 Structure of Haemoglobin. A Three-Dimensional Fourier Synthesis at 5·5-Å. Resolution, Obtained by X-Ray Analysis. *M. F. Perutz, et al.* *Nature*, v. 185, Feb. 13, 1960, p. 416 + 6 pages.

6272 Structure of Myoglobin. A Three-Dimensional Fourier Synthesis at 2 Å. Resolution. *J. C. Kendrew, et al.* *Nature*, v. 185, Feb. 13, 1960, p. 422-427.

6273 Blood Flow Through Narrow Tubes. *Robert H. Haynes.* *Nature*, v. 185, Mar. 5, 1960, p. 679-681.

6274* The Amino Acid-Sequence of Actinomycin C_1 and Actinomycin C_2. *(In German.)* Die Aminosäure-Sequenz von Actinomycin C_1 und Actinomycin C_2. ***H. Brockmann, P. Boldt, and H.-S. Petras.*** *Naturwissenschaften*, v. 47, no. 3, Feb. 1960, p. 62.

6275* The Chemistry of the Blood Group Substances M and N and Its Relation to the Influenza Virus. *(In German.)* Zur Chemie der Blutgruppensubstanzen M und N sowie deren Beziehung zum Influenzavirus. ***Elzbieta Romanovska.*** *Naturwissenschaften*, v. 47, no. 3, Feb. 1960, p. 66.

6276* A Simple Method of Microscopic Observation of the Lysis of Bacteria by Phages. *(In German.)* Eine einfache Methode zur mikroskopischen Beobachtung der Lysis von Bakterien durch Phagen. ***F. Mach.*** *Naturwissenschaften*, v. 47, no. 3, Feb. 1960, p. 67.

6277 Radiation Biology. Proceedings of the Second Australasian Conference on Radiation Biology held at the University of Melbourne, December 15-18, 1958, by the Australian Radiation Society. ***J. H. Martin, editor.*** 304 pp. 1959. Butterworths Scientific Publications, London. (QH652 Au78r)

6278* The Effect of Ultraviolet Light on Some Components of the Nucleic Acids. VI. The Origin of the U.V. Sensitivity of Deoxyribonucleic Acid. *R. Beukers, J. Ijlstra, and W. Berends.* *Recueil des Travaux Chimiques des Pays-Bas*, v. 79, Jan. 1960, p. 101-104.

6279 The Relation of Fungi to Human Affairs. Brings together a discussion of many ways in which fungi affect man's affairs. Primarily, it is designed as a textbook for industrial mycology courses. ***William D. Gray.*** 510 pp. 1959. Henry Holt & Co., Inc., New York. (QK601 G79r)

6280* A Contribution to Human Biochemical Genetics; the Chemical Basis of Blood-Group Specificity. ***W. T. J. Morgan.*** *Royal Society, Proceedings,* v. 151, ser. B, Feb. 2, 1960, p. 308-347.

6281* The Application of Immunological Methods to the Taxonomy of Species Within the Genus *Solanum*. By means of immuno-electrophoretic technique, individual proteins in plant extracts may be differentiated and a number of components in the extracts compared individually with those from related species. Antisera were raised in rabbits to crude saps from S. *tuberosum* and S. *ehrenbergii* (a Mexican species), using a combination of Freund's adjuvant technique with courses of intravenous injections. With both antisera well-marked precipitation lines developed against extracts from all the thirty-eight species examined, and by comparison of the direct "line-spectra" and those obtained after cross-absorption of an antiserum, it was possible to divide the species into groups. ***P. G. H. Gell, J. G. Hawkes, and S. T. C. Wright.*** *Royal Society, Proceedings,* v. 151, ser. B, Feb. 2, 1960, p. 364-383.

6282* The Histocompatibility Requirements of Ovarian Grafts in Mice. The possible exemption of grafts of the endocrine glands from the usual effects of the homograft reaction is one of the important unsolved problems of the immunology of transplantation. Results of these experiments support the view that the homograft reaction against endocrine organs does not differ in vigor from that which is expressed against other normal tissues such as skin. ***P. Hicken and P. L. Krohn.*** *Royal Society, Proceedings,* v. 151, ser. B., Feb. 2, 1960, p. 419-433.

6283 On the Origin of Life. The possibility of recurring biogenesis and the abiotic origin of optical activity are considered. ***John Keosian.*** *Science,* v. 131, Feb. 19, 1960, p. 479-482.

6284 Somatic Radiation Dose for the General Population. The report of the Ad Hoc Committee of the National Committee on Radiation Protection and Measurements, May 6, 1959. *Science,* v. 131, Feb. 19, 1960, p. 482-486.

6285 Separation of Serum Antibody Activities by Anion-Exchange Cellulose Chromatography. ***John L. Fahey.*** *Science,* v. 131, Feb. 19, 1960, p. 500-501.

6286 Interspecific Transformation of *Neisseria* by Culture Slime Containing Deoxyribonucleate. Genetic change of *N. meningitidis* is elicited by deoxyribonucleate from *N. sicca*, not only by deoxyribonucleate obtained from cells by conventional methods but also by crude deoxyribonucleate-containing slime which accumulates without experimental intervention in some cultures incubated for a period as short as 44 hours. ***B. Wesley Catlin.*** *Science,* v. 131, Feb. 26, 1960, p. 608-610.

6287 Serine Derivative With Antitumor Activity. The Na salt of *N*-dichloroacetyl-DL-serine depresses the growth of sarcoma-37 in mice, causing complete regressions of the tumor. The compound is nontoxic to mice in doses up to 4 gm/kg of body weight. The animals do not lose body weight and show no alteration in the formed elements of the blood or in hemoglobin content. ***Irving Levi, Harold Blondal, and Ezra Lozinski.*** *Science,* v. 131, Mar. 4, 1960, p. 666.

6288 Selective Uptake of Serum Globulins and Glycoproteins by Cells Growing in Vitro. Two strains of rat tumor cells (WRC-256 and TSAT-72) utilize alpha-2-globulin more selectively than other protein components of human serum. ***H. Naim Kent and George O. Gey.*** *Science,* v. 131, Mar. 4, 1960, p. 666-668.

6289 Immunoelectrophoresis. Describes process and discusses uses. ***Curtis A. Williams, Jr.*** *Scientific American,* v. 202, no. 3, Mar. 1960, p. 130 + 8 pages.

6290* Tolerance of F_1 Hybrid Skin Homografts in the Parent Strain Induced by Parabiosis. ***C. Martinez, et al.*** *Society for Experimental Biology and Medicine, Proceedings,* v. 103, no. 2, Feb. 1960, p. 266-268.

6291* Effect of Methyl Bis (2-Chlorethyl) Amine Upon Survival of Skin Homografts in Rats and Rabbits. ***D. G. McQuarrie, et al.*** *Society for Experimental Biology and Medicine, Proceedings,* v. 103, no. 2, Feb. 1960, p. 278-282.

6292* Chromatography of Proteins of Squamous Cell Carcinomas and Normal Epithelium of Mice. ***Pietro U. Angeletti, Blake W. Moore, Stojan Solaric, and Valentina Suntzeff.*** *Society for Experimental Biology and Medicine, Proceedings,* v. 103, no. 2, Feb. 1960, p. 329-331.

6293* Cytotoxic Action of Normal Human Serum on Ehrlich Ascites and Sarcoma 180 Cells. Thermolabile, nondialyzable cytotoxins are present in normal, human serum for Ehrlich ascites and Sarcoma 180 cells. Similarities and differences of these cytotoxins and those active against atypical human cell strains U12 and HeLa are described. ***Robert P. Bolande and John P. McClain.*** *Society for Experimental Biology and Medicine, Proceedings,* v. 103, no. 2, Feb. 1960, p. 345-347.

6294* Studies in Leukemia: XIV. Effect of Human Serum on Development of Leukemia in AKR Mice. Human volunteers were inoculated with a cell-free filtrate prepared from a pool of brains obtained from patients who died of acute leukemia. The antiserum from these volunteers afforded significant protection of AKR mice challenged with cell-free filtrates of leukemic human brains. This protection was not afforded by pooled normal serum, and was apparent at various dilutions of the challenging material. ***Constantin Logothetis, et al.*** *Society for Experimental Biology and Medicine, Proceedings,* v. 103, no. 2, Feb. 1960, p. 420-421.

6295 A Source-Book of Biological Names and Terms. ***Edmund C. Jaeger.*** 3rd Ed. 319 pp. 1959. *Charles C. Thomas,* Springfield, Illinois. (QH83 J17s3)

6296 Structure and Function of Genetic Elements. Report of symposium held June 1-3, 1959, No. 12, 187 pp. 1959. Brookhaven National Laboratory, Upton, New York. (QH573 Un3.1s)

6297 Mathematical Models for the Formation and Regulation of Populations of Formed Blood Elements. I. Some Basic Concepts and a First Specific Model. ***George A. Sacher, Ernesto Trucco, and John H. Borrowman.*** *U. S. Atomic Energy Commission, ANL-6093,* p. 46-54. (UF767 Un3.1an Contin.)

6298* Limited Fixation of Antibody by Viable Cells. Antibody, active against human connective tissue was fixed only at the cell surface of viable HeLa cells and was able to react with intracellular cytoplasmic components only in killed cells. ***Raymond Hiramoto, Milton N. Goldstein, and David Pressman.*** *U. S. National Cancer Institute, Journal,* v. 24, no. 2, Feb. 1960, p. 255-259 + 2 plates.

6299* Effects of Glucose Analogues (2-Deoxy-D-glucose, 2-Deoxy-D-galactose) on Experimental Tumors. Inhibition of tumor growth was noted in each instance and a modest prolongation of survival time attained with most tumors. ***John Laszlo, Stewart R. Humphreys, and Abraham Goldin.*** *U. S. National Cancer Institute, Journal,* v. 24, no. 2, Feb. 1960, p. 267-279 + 1 plate.

6300* Virus of Avian Myeloblastosis. XIV. Neoplastic Response of Normal Chicken Bone Marrow Treated With the Virus in Tissue Culture. After an interval of 12 to 20 days, there was multiplication of cells with the characteristics of myeloblasts. With increase in growth of myeloblasts, there was an associated liberation of myeloblastosis virus into the culture fluid. ***G. S. Beaudreau, et al.*** *U. S. National Cancer Institute, Journal,* v. 24, no. 2, Feb. 1960, p. 395-408 + 4 plates.

See also: **6223** (physiology of insect development); **6511** (fungicides in surface coatings).

CERAMICS AND CONCRETE

6301 Phase Equilibria in the System ZnO-TiO_2. The system ZnO-TiO_2 has been investigated using quenching, hydrothermal, strip-furnace, and solid-state-reaction techniques. Two compounds were found: Zn_2TiO_4, which melts congruently at 1549 C, and $ZnTiO_3$, which dissociates hydrothermally at 945 C

to give Zn_2TiO_4 and rutile. Two eutectics were found: one between ZnO and Zn_2TiO_4 at 32 mole % TiO_2 and 1537 C and the other between Zn_2TiO_4 and TiO_2 at 58 mole % TiO_2 and 1418 C. ***F. H. Dulin and D. E. Rase.*** *American Ceramic Society, Journal*, v. 43, Mar. 1960, p. 125-131.

6302 Pressure-Temperature-Density Relationships in Several Samples of UO_2. Preliminary studies were made of certain process variables in the manufacture of high density urania bodies. Independent variables include: (a) reaction used to make UO_2, (b) ball-milling of UO_2, (c) pressing pressure, and (d) sintering temperature. The dependent variable was product density although other information such as grain size, linear shrinkage, and compressive strength was collected. ***W. G. Carlson, H. D. Root, and R. S. Shane.*** *American Ceramic Society Bulletin*, v. 39, Feb. 1960, p. 69-73.

6303 Ceramic Statistics. Charts and tables compare production or consumption of ceramic products with various other materials in the U. S. Data indicate that the ceramic industry is keeping pace with other industries in our growing American economy. ***Betty Deem and John D. Sullivan.*** *American Ceramic Society Bulletin*, v. 39, Feb. 1960, p. 74-77.

6304* Long-Time Study of Cement Performance in Concrete. XII. Concrete Exposed to Sea Water and Fresh Water. During 1941 and 1942 four experimental installations of test piling were driven, three in sea water and one in fresh water, for studies of concrete performance. Twenty-two of the 27 long-time study cements were used in three eastern exposures; seven were used in California. After more than 15 years, significant trends in performance are developing. ***I. L. Tyler.*** *American Concrete Institute, Journal*, v. 31; *ACI Proceedings*, v. 56, no. 9, Mar. 1960, p. 825-836.

6305* Effects of Incomplete Consolidation on Compressive and Flexural Strength, Ultrasonic Pulse Velocity, and Dynamic Modulus of Elasticity of Concrete. Concrete mixes having cement:aggregate:water ratios of 1:3:0.35, 1:6:0.50, and 1:9:0.66, by weight, were used to make 20 x 4 x 4-in. beams and 6-in. cubes for resonant frequency and flexural and compressive strength tests. The amount of consolidation was varied by vibrating the concrete for different lengths of time. The maximum void content was 32%. ***M. F. Kaplan.*** *American Concrete Institute, Journal*, v. 31; *ACI Proceedings*, v. 56, no. 9, Mar. 1960, p. 853-867.

6306* Bearing Capacity of Concrete Blocks. Laboratory tests were conducted to determine the bearing capacity of square concrete blocks whose area is 2 to 16 times the contact area and whose depth equals either full or half width of the block. Two concrete mixes with different maximum aggregate size were used for a total of 60 test specimens. The test results were plotted in dimensionless coordinates, with the ratio of bearing capacity to unconfined compressive cylinder strength as ordinate and the ratio of block area to contact area as abscissa. A rational interpretation of the test results is suggested. ***Tung Au and Donald L. Baird.*** *American Concrete Institute, Journal*, v. 31; *ACI Proceedings*, v. 56, no. 9, Mar. 1960, p. 869-879.

6307 Temperatures, Thermal Stresses and Displacements in Solid Uranium Dioxide Rods. Expressions are derived for the temperatures, stresses and displacements in a solid uranium dioxide fuel rod, the thermal conductivity of which decreases exponentially with temperature. Graphs of the temperatures and displacements are given, and calculation shows that the rod will fracture when the center-to-surface temperature drop exceeds 80-90 C. ***J. P. Ellington.*** *British Journal of Applied Physics*, v. 11, Jan. 1960, p. 33-35.

6308 Fracture of Ceramic Materials. Describes microscopic observations of deformed and etched MgO single crystals. Etch-pit studies reveal slip bands densely populated with dislocations and that these slip bands act as barriers to dislocations on intersecting slip planes. Cleavage cracks on $\{001\}$ and $\{011\}$ planes were found at the junctions of intersecting slip bands. The formation of these cracks was evidently associated with the high local stresses produced by dislocation pile-ups. ***Earl R. Parker.*** Paper from "Fracture", p. 181-192, 1959. John Wiley & Sons, New York. (TA405 In8f)

6309 The Strength of Silicate Glasses and Some Crystalline Oxides. Reviews the role of atmospheric fatigue in the failure of silicate glasses and reparts results of an experimental survey of the fatigue effects in a number of common oxides and silicates. Deteriorating effect of atmospheric water vapor on the strength of oxide materials, both crystalline and amorphous, is perhaps more pronounced and more general than is usually recognized. ***R. J. Charles.*** Paper from "Fracture", p. 225-249, 1959. John Wiley & Sons, New York. (TA405 In8f)

6310 Effect of Fission Recoil Fragments on the Thermal Conductivity of Graphite. The variation of the thermal conductivity of U-impregnated graphite is measured continuously while under neutron irradiation. The temperature is continuously monitored and results are reported which show the effects of the U oxide particle size as well as the effect of the neutron bombardment as separated from the fission recoil bombardment. ***L. P. Hunter.*** *Journal of Applied Physics*, v. 30, Dec. 1959, p. 1969-1975.

6311 The Strength of Glass Fibres. Experiments suggest source of stress causing flaws in the surface of glass fibers. It is believed that these flaws are the major ones concerning strength of fibers drawn at low temperatures. ***D. G. Holloway.*** *Philosophical Magazine*, v. 4, ser. 8, Oct. 1959, p. 1101-1106.

6312 Reactors vs. Materials. Fused silica heat exchangers and other parts for nuclear reactors are made by slip-casting fused silica in porous molds. ***J. D. Fleming.*** *Research Engineer*, v. 15, no. 1, Feb. 1960, p. 10-11.

6313 High Conductivity UO_2—Terminal Report. Work to improve the thermal conductivity of UO_2 fuel elements by small additions of CeO_2, Y_2O_3, and Nb_2O_5,in 0.25, 1.0, and 4.0 mol % amounts. Thermal conductivity measurements indicated that Y_2O_3 additions do cause an increase in the thermal conductivity at one and four mol % addition levels. UO_2 plus 0.25 mol % Nb_2O_5 had lower thermal conductivity and higher electrical resistance than UO_2. ***H. Shapiro and R. M. Powers.*** *U. S. Atomic Energy Commission, SCNC-294*, Oct. 1959, 43 pp. (UF767 Un3.1scn Contin.)

6314 Uranium Dioxide Compatibility With Refractory Metals, Carbides, Borides, Nitrides, and Oxides Between 3500° and 5000° F. Compatibility with 30 refractory materials was determined in vacuum or in Ar for test times of 10 min. and for test temperatures in the 3500 to 5000 F range. Hafnium carbide, tantalum nitride, W, and Ta were compatible with UO_2 up to 5000 F; Mo and Cb were compatible up to their melting points. Others were compatible at slightly lower temperatures. ***James J. Gangler, William A. Sanders and Isadore L. Drell.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-262*, Feb. 1960, 28 pp. (TL570 Un3t Vis.)

See also: **6325** (selection of brick-lined process equipment).

CHEMICAL ENGINEERING

6315* Investigation of the Heating Process of Moist Materials by Means of High Frequency Currents. Approximate formulas to determine the temperature and moisture of capillary-porous materials (dielectrics and semiconductors) as a function of time were derived. The value of the excess of vapor pressure in the heated body was calculated, account being taken of the dependency of the power of the heat source on the temperature and moisture of the body. (*In Russian.*) Issledovanie protsessa nagreva vlazhnykh materialov tokami vysokoi chastoty. ***N. P. Zhmakin.*** *Akademiia Navuk Belaruskaia SSR, Doklady*, v. 4, no. 1, Jan. 1960, p. 20-23.

6316* Sulfonation With Sulfur Trioxide: Detergent Alkylate in a Scraping-Blade Heat Exchanger. ***Albert Abrams, Emery J. Carlson, Everett E. Gilbert, and Harry R. Nychka.*** *American Oil Chemists' Society, Journal*, v. 37, Feb. 1960, p. 63-68.

6317* Direct Solvent-Extraction of Castor Beans Yields High Grade Oil. Data on five lots of castor beans are presented to show that the filtration-extraction process can be successfully applied on a bench scale to whole or decorticated castor beans to yield a meal product with residual lipids content of 1% or less

and high quality crude oil. Conditions suitable for extraction are given. ***E. L. D'Aquin, et al.*** *American Oil Chemists' Society, Journal,* v. 37, Feb. 1960, p. 93-97.

6318* A Comparative Study of Pharmaceutical Emulsification Equipment. Evaluation of the emulsion products involved measurements of particle size distribution, rate of creaming, and viscosity. ***Garnet E. Peck, H. George Dekay, and Gilbert S. Banker.*** *American Pharmaceutical Association, Journal (Scientific Ed.),* v. 49, Feb. 1960, p. 75-79.

6319* Recent Syntheses Using Carbon Monoxide. The application of CO in the oxo synthesis as well as of CO and C_2H_2 in the synthesis of acrylic acid have opened a wide field for science and technology. Describes new reactions of chloroallyl compounds with CO and C_2H_2 in the presence of nickel carbonyl in which unsaturated carboxylic acids were obtained. (*In German.*) Neuere Synthesen mit Kohlenmonoxyd. ***G. P. Chiusoli.*** *Angewandte Chemie,* v. 72, no. 2, Jan. 21, 1960, p. 74-76.

6320* Automatic Control of Fractionating Columns. Briefly reviews the elements of automatic control theory as applied to the control of fractionating columns. ***N. J. Hassett.*** *British Chemical Engineering,* v. 5, Feb. 1960, p. 95-98.

6321* A 'Purity Meter' for Liquid Streams. A 'made in Canada' stream analyzer monitors military jet fuel for solid contaminants. *Canadian Chemical Processing,* v. 44, Feb. 1960, p. 43 + 1 page.

6322* Performance of Flow Reactors at Various Levels of Mixing. Chemical flow reactors studied include models in which partial mixing and piston flow are present and others which involve partial mixing and short-circuit. ***A. Cholette, J. Blanchet, and Léonce Cloutier.*** *Canadian Journal of Chemical Engineering,* v. 38, no. 1, Feb. 1960, p. 1-18.

6323* A Simplified Method for Determination of Solid Diffusion Coefficient With Non-Linear Adsorption Isotherm. ***Chi Tien.*** *Canadian Journal of Chemical Engineering,* v. 38, no. 1, Feb. 1960, p. 25-28.

6324 High-Pressure Acetylene Chemicals. Flowsheet and description for making C_2H_2 derivatives via high-pressure synthesis. ***R. A. Labine.*** *Chemical Engineering,* v. 67, Feb. 22, 1960, p. 112-115.

6325 How to Select and Design Brick-Lined Process Equipment. ***Donald Thompson.*** *Chemical Engineering,* v. 67, Feb. 22, 1960, p. 129-134.

6326 How Heat Transfer Occurs in Evaporators. ***Jesse Coates and Bernard S. Pressburg.*** *Chemical Engineering,* v. 67, Feb. 22, 1960, p. 139 + 4 pages.

6327* Soda Ash From Trona. Modern trend is to make soda ash from less costly, and practically unlimited supplies of trona. ***Howard A. Sommers.*** *Chemical Engineering Progress,* v. 56, Feb. 1960, p. 76-79.

6328* Purify Liquid Oxygen Via Adsorption. Experimental data cast new light on significance of pressure, concentration, and nature of contaminant. ***A. C. T. Hsu and Clyde McKinley.*** *Chemical Engineering Progress,* v. 56, Feb. 1960, p. 80-84.

6329* Irradiation Techniques in Chemical Processing. ***J. W. Ranftl.*** *Chemical Engineering Progress,* v. 56, Feb. 1960, p. 96 + 2 pages.

6330 Now: Quality Control for Mineral Processing. Rock salt crystals flow from the feed hopper onto a vibrating-screen conveyor which transports the salt for one minute under a bank of infrared heating lamps. An accelerating chute spreads the crystal mix onto a belt coated with heat-sensitive resin. The cool pure salt falls into a product bin; while warmer, impure salt is carried to a reject bin. ***O. F. Tangel and R. T. Brison.*** *Chemical Week,* v. 86, no. 8, Feb. 20, 1960, p. 28-29.

6331* Heat Transfer to Heat Exchangers in a Moving Bed. It is possible to employ tubes through which the pulverulent material flows axially, or tubes across which the flow occurs and arranged in staggered layout, for heat transfer via heat-exchanger surfaces in the moving bed, spray drier or similar reaction apparatus. With exchange elements where the flow is transverse to them, comparatively small total exchange surface is necessary and high heat-transfer coefficients are achieved. The optimum values which can be obtained fall with increasing particle diameter of the pulverulent material. (*In German.*) Wärmeübergang an Wärmeaustauschern im Moving Bed. ***Rudolf Ernst.*** *Chemie-Ingenieur-Technik,* v. 32, Jan. 1960, p. 17-22.

6332* Fume Disposal in the Manufacture of Phthalic Anhydride. ***R. W. Fugler.*** *Chemistry in Canada,* v. 12, Feb. 1960, p. 28-30.

6333* Mass Transfer Coefficient in Distillation in Packed Columns. To define operating conditions of optimum efficiency in packed distillation columns, the following parameters in the distillation of toluene-*n*.heptane and toluene-methylcyclohexane were examined: mean concentration, liquid and vapor flow, at total and partial reflux. Experimental results were correlated by modified expressions of the Chilton-Colburn theory. (*In Italian.*) Coefficienti di trasporto nella distillazione con corpi di riempimento. ***Alberto Paratella.*** *Chimica e l'Industria,* v. 42, Jan. 1960, p. 7-11.

6334* Production of Boric Acid From Colemanite. A new process for the production of boric acid from minerals consisting essentially of colemanite. The mineral is attacked by hot carbammoniacal solutions; after filtration and ammonia distillation, boric acid of high purity is separated by crystallization. The influence of attack procedure, and of size and calcination of the mineral on process yields and on reaction rate was studied. (*In Italian.*) Sulla produzione di acido borico da colemanite. ***C. Garbato, M. Giorgini, and G. F. Nencetti.*** *Chimica e l'Industria,* v. 42, Jan. 1960, p. 20-26.

6335* Contribution to the Control of Gaseous Filaments Flowing in Reactors. Some reactions between gases take place in a large container which constitutes the reactor itself. For the benefit of the reaction, it is absolutely necessary to control the progress and the expansion of the gaseous filaments from the very issue of the inlet nozzle. For efficient control, it is necessary to employ the properties of jets, so as to avoid encumbering the reactor with solid elements. (*In French.*) Contribution au contrôle de l'écoulement des veines gazeuses dans les réacteurs. ***M. R. Drouhin.*** *Chimie & Industrie (Génie Chimique),* v. 83, no. 1, Jan. 1960, p. 15-22.

6336* Catalytic Desulfuration of Town-Gas and of Industrial Gases by Contact Masses Composed of Mixed Non-Metallic Crystals Similar in Structure to the Raney Phases. Considers the desulfuration process of gases not only as a catalytic process but also as a chemical reaction. It is deduced that for a high activity and a good absorption capacity of H_2S, these masses must have the following qualities: shrinking and perturbation of the crystalline network, elementary particles as small as possible, presence of a sufficient quantity of water and of a certain alkalinity, surface as large as possible. (*In French.*) La désulfuration catalytique du gaz d'éclairage et des gaz industriels au moyen de masses de contact à ((squelette)), composées de cristaux mixtes non métalliques, de structure analogue aux phases de raney. ***A. Simon and M. Lang.*** *Chimie & Industrie,* v. 83, no. 1, Jan. 1960, p. 67-75.

6337* The Formation of Insoluble Material During the Distillation of Tar. ***J. W. Smith and E. J. Greenhow.*** *Fuel,* v. 39, no. 1, Jan. 1960, p. 5-9.

6338* Electrical Heating of Industrial Plant. II. Several electrical heaters are discussed. Sketches and cross sections of electrical heating installations are given. ***A. E. Williams.*** *Fuel Efficiency,* v. 8, Feb. 1960, p. 32-35.

6339 EDTA, Ethylenediaminetetraacetic Acid. The textile industry is the largest single user of EDTA, but producers are hopefully eyeing such fields as agriculture, electroplating, mineral separations, and food additives. ***Earl V. Anderson and John A. Gaunt.*** *Industrial and Engineering Chemistry,* v. 52, Mar. 1960, p. 190-196.

6340 Isomerization of *n*-Heptane. Aluminum Chloride—Hydrocarbon Complex Catalyst. *n*-Heptane was isomerized by an aluminum chloride-hydrocarbon complex catalyst. Isobutane was used to suppress disproportionation. Nearly complete con-

version of *n*-heptane to other products was obtained in 15 minutes at 110 F. At five moles isobutane per mole *n*-heptane, an isoheptane yield of 70% was obtained. ***H. J. Hepp and L. E. Drehman.*** *Industrial and Engineering Chemistry*, v. 52, Mar. 1960, p. 207-210.

6341 A Belgian Process for Ammonia Manufacture. Process for the manufacture of NH_3 from light hydrocarbons. *Industrial Chemist*, v. 36, Feb. 1960, p. 61-64.

6342 Industrial Applications of the Metal Organic Compounds. Industrial applications of Be organic compounds and their future possibilities. Aryls, alkoxides, carboxylic acid salts, and acetates are discussed. ***J. H. Harwood.*** *Industrial Chemist*, v. 36, Feb. 1960, p. 74-76.

6343 Selas Hydrogen Generator Plant Features New System of Generation and Purification. *Industrial Heating*, v. 27, Feb. 1960, p. 336 + 1 page.

6344 Adsorption on Porous Solids. ***Bert H. Clampitt and Dale E. German.*** *Journal of Physical Chemistry*, v. 64, Feb. 1960, p. 284-286.

6345 The Nation's Water Resources. Five papers by authorities from industry, research laboratories, and federal agencies. *Mechanical Engineering*, v. 82, Jan. 1960, p. 31-36.

6346* Play Safe With Your Solvents. When dealing with non-inflammable chlorinated hydrocarbon solvents observe the following rules: Keep the solvent in a cool place; do not allow the solvent to stand in buckets; avoid unnecessary breathing of the vapor; avoid contact with the skin; do not allow solvent or solvent vapor to come into contact with flames or red-hot surfaces. *Metalworking Production*, v. 104, no. 4, Jan. 27, 1960, p. 162.

6347* Development of Centrifugal Pumps for Operation With Liquid Metals and Molten Salts at 1100-1500°F. Sump-type centrifugal pumps ranging in capacity from 2-1500 gpm have been developed for circulating liquid metals and molten salts up to 1500 F in metallurgical, heat transfer, and reactor experiments. Each of these pumps uses a nearly conventional bearing assembly to support a vertical shaft and an impeller suspended in a tank containing the high-temperature liquid and an inert blanketing gas. Problems resolved in the development of these pumps are discussed. ***A. G. Grindell, W. F. Boudreau, and H. W. Savage.*** *Nuclear Science and Engineering*, v. 7, Jan. 1960, p. 83-91.

6348 How Furfural Refining Increases Gasoline Production in Two Texaco Cat Crackers. ***R. R. Dickinson and C. B. Longsworth.*** *Oil and Gas Journal*, v. 58, no. 8, Feb. 22, 1960, p. 120 + 4 pages.

6349 New Catalyst Converts Higher Percentage of Ethylene in Making Ethylbenzene. A solid phosphoric acid catalyst is now in use for production of ethylbenzene and cumene. It has higher activity toward the primary alkylation reaction and lower activity toward the undesirable polymerization side reaction. ***Edwin K. Jones.*** *Oil and Gas Journal*, v. 58, no. 9, Feb. 29, 1960, p. 80.

6350* Time to Think About Disposal of Water Treatment Wastes. End products of water purification can cause stream pollution, so this article outlines the problems involved and indicates what to do about them now. ***E. G. Paulson.*** *Plant*, v. 21, Feb. 1960, p. 47-50.

6351 How Much Power to Pump Liquids? Nomograph gives quick answers for pump capacities from 0.1 to 1000 gpm, and pressures from 1 to 10,000 psi. ***Tyler G. Hicks.*** *Product Engineering*, v. 31, no. 8, Feb. 22, 1960, p. 59.

6352 Research Snuffs Smells. Describes research on odors, their cause and counteraction for use in industry. *Research/Development*, v. 11, Jan. 1960, p. 76-78.

6353 Low Foam Nonionic Surfactants. Modified nonionic surfactants having low foam properties, even under severe agitation, still retain their useful surface active properties. ***J. Dupre, R. E. Wolfrom, and D. R. Fordyce.*** *Soap and Chemical Specialties*, v. 36, Feb. 1960, p. 55 + 5 pages.

6354 Insect Attractants. New insect lures, natural or synthetic, may supply answer to insect detection. Combined with toxicants they may offer chance of eradication of certain species. ***Morton Beroza.*** *Soap and Chemical Specialties*, v. 36, Feb. 1960, p. 74 + 3 pages.

6355* Exploratory Studies in the Development of Essential Oils and Their Constituents in Aromatic Plants. II. Oils of Camphor, Chenopodium, Citronella, and Peppermint. Sources of camphor and oil of camphor, oil of chenopodium, oil of citronella and oil of peppermint are described and discussed. ***Sadgopal.*** *Soap, Perfumery & Cosmetics*, v. 33, Feb. 1960, p. 159-167.

6356* The Production of Liquid Syndetergents From Alkyl Benzene Sulphonic Acid. ***A. Davidsohn.*** *Soap, Perfumery & Cosmetics*, v. 33, Feb. 1960, p. 176-180.

6357* Fragrance in the Natural Orders. XXXVII. The *Cucurbitaceae* or Gourd Family. XXXVIII. The *Crassulaceae*. The fragrance of *cucurbita moshata, C. cerifera, crassula moschata, Kalosanthes coccinea* and of others is described. ***E. S. Maurer.*** *Soap, Perfumery & Cosmetics*, v. 33, Feb. 1960, p. 196 + 1 page.

6358* Using Solar Energy for Heating the Air Used in Technical Drying Processes. The drying house has a double roofing with an air space between. The upper roof consists of Al plates painted black, the lower roof of an insulating material. Under conditions of excess incoming radiation the air between the roofs is heated, and subsequently used for drying. (*In Norwegian.*) Solenergi til oppvarmning av luft ved tekniske tørkeprosesser. ***Eilif Dahl and G. Kvifte.*** *Teknisk Ukeblad*, v. 107, no. 3, Jan. 21, 1960, p. 41-46.

6359* Drying by Means of Sun-Heated Air. The initial temperature of the air influences the thermal efficiency of the process. A case where the air collects solar energy by passing through a duct under a black metal roof and is thereby heated 10 C, is investigated. The contribution of the solar energy increased the drying capacity of the outdoor air by approximately 50%. (*In Norwegian.*) Tørking med soloppvarmet luft. ***H. Westergaard.*** *Teknisk Ukeblad*, v. 107, no. 3, Jan. 21, 1960, p. 47-49.

6360* Vapor-Liquid Equilibrium Measurements at Low Pressure. Tests of the still and vapor-liquid equilibria for mixtures of di-*n*-butylphthalate–di-*n*-butylsebacate at 1 mm Hg are reported together with preliminary results for ethanol-water mixtures at 4, 10, 50, and 95 mm Hg. (*In Norwegian.*) Damp–vaeske likevektsmålinger ved lave trykk. ***Aksel Lydersen.*** *Tidsskrift for Kjemi, Bergvesen og Metallurgi*, v. 19, no. 10, 1959, p. 222-224.

6361 Effects of Antioxidants on Asphalt Durability. Mechanism is studied by observing the action of materials which inhibit degradation. Inhibitors of chain reactions in some cases inhibited weight loss without extending durability. Compounds which decompose peroxides were observed to be capable of extending the durability of an asphalt and also of retarding weight loss. ***Burton D. Beitchman.*** *U. S. National Bureau of Standards, Journal of Research, Section C, Engineering and Instrumentation*, v. 64, no. 1, Jan.-Mar. 1960, p. 13-17.

See also: **6733** (centrifugal purification of fuel oil); **6769** (energy input in comminution); **7146** (recovery of U from U-Zr fuel scrap).

CHEMISTRY—ANALYTICAL

6362* Studies in the Determination of Silica. II. The Separation of Phosphomolybdate From α-Silicomolybdate. Experiments show that it is possible to separate quantitatively phosphomolybdate from α-silicomolybdate by extracting water phases with *n*-butanol or *n*-butanol-benzene mixtures under certain specified conditions. ***Lars Henrik Andersson.*** *Acta Chemica Scandinavica*, v. 13, no. 9, 1959, p. 1743-1752.

6363* Addition Compounds of Diphosphorus Trioxide Tetrachloride. $2SbCl_5 \cdot P_2O_3Cl_4$ and $SnCl_4 \cdot P_2O_3Cl_4$ were prepared and their infrared spectra recorded. ***Ingvar Lindqvist,***

Margareta Zackrisson, and Sigvard Eriksson. *Acta Chemica Scandinavica*, v. 13, no. 9, 1959, p. 1758-1760.

6364* Quantitative Paper Chromatography of Carotenoids. A highly selective, rapid, and simple method for the quantitative, circular chromatography of carotenoids on a commercially available paper with a kieselguhr filler is described. ***Arne Jensen and Synnøve Liaaen Jensen.*** *Acta Chemica Scandinavica*, v. 13, no. 9, 1959, p. 1863-1868.

6365* A Combustion Method for the Determination of Solvent Vapors at Low Concentrations in Air. ***Robert Goldstein, Joseph Gliksman, and Jack H. Elliott.*** *Air Pollution Control Association, Journal*, v. 10, no. 1, Feb. 1960, p. 45-53.

6366 Significance of Reported Chemical Analysis of Cast Iron. Chemical analysis data, reported by more than 30 laboratories for 40 samples of cast iron over a period of 15 years, indicate that limits for accuracy and reproducibility are greater than commonly assumed. The range for reported analyses from a large group of laboratories will be about three times as great as that obtained by one laboratory for the same sample of iron. The existence of this somewhat broad range for reported analysis of cast iron in the literature must be recognized when evaluating the relationship of chemical composition of cast iron to its mechanical and physical properties. ***D. E. Krause.*** *American Foundrymen's Society, Transactions*, v. 67, 1959, p. 705-714. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6367* The Mode of Coordination of Amino Acids With Cationic Chromium in Acid Aqueous Solutions. II. Potentiometric Titration. ***S. G. Shuttleworth and R. L. Sykes.*** *American Leather Chemists Association, Journal*, v. 55, Mar. 1960, p. 154-163.

6368* Infrared Spectroscopic Characterization of Glycerides. Polymorphic form, chain length, type of unsaturation and configuration are all revealed by the spectra of tri-, di-, and monoglycerides. ***Dennis Chapman.*** *American Oil Chemists' Society, Journal*, v. 37, Feb. 1960, p. 73-77.

6369* Suggested Method for Nitrate Determination With 2,6-Xylenol Reagent. A spectrophotometric method for determining nitrate ions in water which requires less than ten minutes. ***Arnold M. Hartley and Richard I. Asai.*** *American Water Works Association, Journal*, v. 52, Feb. 1960, p. 255-258.

6370* Determination of Carbonate Alkalinity in Natural Waters. ***J. F. J. Thomas and J. J. Lynch.*** *American Water Works Association, Journal*, v. 52, Feb. 1960, p. 259-268.

6371* The Colorimetric Determination of Orthophosphate in the Presence of Condensed Phosphates. ***Krishna Kumar Tewari and P. S. Krishnan.*** *Analytica Chimica Acta*, v. 22, no. 2, Feb. 1960, p. 111-117.

6372* A Rapid Method for the Determination of Organic Carbon in Soil. The method is suitable for all soils except those containing much chloride or reducing substances other than organic carbon. Carbonates do not interfere. ***L. J. Mebius.*** *Analytica Chimica Acta*, v. 22, no. 2, Feb. 1960, p. 120-124.

6373* The Spectrochemical Determination of Total Strontium in Bone, Milk and Vegetation. Samples of bone ash are mixed with anhydrous copper sulfate and graphite and pelleted. A dc arc is used to excite the spectra which are then evaluated by microphotometry. In the case of milk and vegetation, Sr and Ca are separated as insoluble oxalates and the Sr content of this fraction determined by a method similar to that used for bones. ***R. V. Jury, M. S. W. Webb, and R. J. Webb.*** *Analytica Chimica Acta*, v. 22, no. 2, Feb. 1960, p. 145-152.

6374* The Micro-Determination of Gold With *p*-Dimethylaminobenzylidenerhodanine. ***T. M. Cotton and A. A. Woolf.*** *Analytica Chimica Acta*, v. 22, no. 2, Feb. 1960, p. 192-194.

6375 Determination of Radioactive Sulfur in Biological Materials. Method for determining radioactive S-35 in biological materials uses oxidation of the sample to magnesium sulfate which is dissolved in glycerol and diluted with ethyl alcohol and *N,N*-dimethylformamide. Phosphors containing toluene are added and the sample counted in a liquid scintillation counter. ***Henry Jeffay, Funso O. Olubajo, and William R. Jewell.*** *Analytical Chemistry*, v. 32, Mar. 1960, p. 306-308.

6376 Determination of Hydrocarbon Oxidation Products, Reverse Isotope Dilution Analysis. Reverse isotope dilution analysis is employed to determine the products from the radiation-induced oxidation of propane over zinc oxide. Individual members of a homologous series are determined without interference by using recrystallization of a derivative as the purification method. ***William H. Clingman, Jr., and Harold H. Hammen.*** *Analytical Chemistry*, v. 32, Mar. 1960, p. 323-325.

6377 Rapid Method for Semiquantitative Determination of Volatile Aldehydes, Ketones, and Acids. Flash Exchange Gas Chromatography. Derivatives of volatile compounds are heated with reagents in a capillary tube and the products volatilized directly into a gas chromatography unit. The technique is applicable to determination of flavor components of vegetables. ***Jack W. Ralls.*** *Analytical Chemistry*, v. 32, Mar. 1960, p. 332-336.

6378 Gas Chromatographic Analysis of Olefinic Naphthas in the Three- to Six-Carbon Range. With the Aid of a Subtraction Technique. Method is based on the use of successive runs in the presence and absence of olefins. Separate runs are made with and without an absorber which removes olefins from the solution. Wide variations of three to six carbon components are found in typical olefinic naphthas. ***Ronald L. Martin.*** *Analytical Chemistry*, v. 32, Mar. 1960, p. 336-338.

6379 Polarographic Characteristics of Ammonium Ion and Ammonia. ***C. J. Nyman, J. L. Ragle, and Peter F. Linde.*** *Analytical Chemistry*, v. 32, Mar. 1960, p. 352-355.

6380 Polarographic Determination of Styrene Monomer in Polyester Resins. The sample is dissolved in ethyl alcohol and polarographed in tetrabutylammonium chloride. ***William M. Ayres and Gerald C. Whitnack.*** *Analytical Chemistry*, v. 32, Mar. 1960, p. 358-360.

6381 Separation of Cadmium From Uranium, Cobalt, Nickel, Manganese, Zinc, Copper, Titanium, and Other Elements by Cation Exchange Chromatography. Using AG 50W-X8 exchange resin, Cd is eluted with 0.5*N* HCl. Stannic tin indicates a response similar to Cd and may be quantitatively separated from cation solutions with the same technique. ***F. W. E. Strelow.*** *Analytical Chemistry*, v. 32, Mar. 1960, p. 363-365.

6382 A Continuous Gas Titration Analyzer for Fluorine. Continuous automatic fluorine analyzer for monitoring and control of complex gas systems. Operates on the basis of the pneumatic detection of the reduction in molar flow as fluorine reacts with SO_2. Other gases may be analyzed by changing the reagent and reactor conditions. ***C. W. Weber.*** *Analytical Chemistry*, v. 32, Mar. 1960, p. 387-391.

6383 Gravimetric Determination of Bismuth With Dimethylglyoxime. From 50 to 500 mg of Bi were determined by precipitation of Bi with dimethylglyoxime at pH 11.0 to 11.5 EDTA and KCN were employed as masking agents. ***Peter F. Lott and Richard K. Vitek.*** *Analytical Chemistry*, v. 32, Mar. 1960, p. 391-393.

6384 Determination of Sulfur in Petroleum Products by Hydrogenation. Sulfur is converted to H_2S and absorbed in dilute NaOH solution. This is followed by amperometric titration with standard $HgCl_2$ if the S concentration is above 0.1%. Below 0.1% the methylene blue method is used. ***E. C. Schluter, Jr., E. P. Parry, and George Matsuyama.*** *Analytical Chemistry*, v. 32, Mar. 1960, p. 413-417.

6385 Analytical Chemistry of Titanium Metals and Compounds. A reference book of Ti analysis methods gathered from publications and unpublished laboratory reports. ***Maurice Codell.*** v. IX. 378 pp. 1959. Interscience Publishers, Inc., New York. (QD181.T6 C64s)

6386* Paper Chromatography of 3-Amino-1,2,4-Trazole. ***Lloyd C. Mitchell.*** *Association of Official Agricultural Chemists, Journal*, v. 43, no. 1, Feb. 1960, p. 87-88.

6387* Identification of Pesticide Residues in Extracts of Fruit, Vegetables, and Animal Fats. II. Rapid Qualitative Chemical Tests for Captan and Methoxychlor. Each of the tests described will detect as little as 3 mmg of compound and there was no interference from extraneous material or other pesticides tested. ***W. P. McKinley and Sheila I. Graham.***

Association of Official Agricultural Chemists, Journal, v. 43, no. 1, Feb. 1960, p. 89-91.

6388* Separation of Phosphate Esters by Paper Chromatography. Procedure for the separation of phosphate esters at room temperature using ethyl acetate-acetic acid-water in one direction and methyl ethyl ketone-methyl cellosolve-ammonia in the second direction. ***D. A. Rappoport and P. T. Chen.*** *Biochimica et Biophysica Acta*, v. 38, no. 1, Feb. 12, 1960, p. 156-157.

6389* Simple Electronic Voltmeter for Potentiometric Titration. Describes the scheme and operation of a simple electronic voltmeter for serial potentiometric titration. *(In Russian.)* Prostoĭ elektronnyĭ vol'tmetr dlia potentsiometricheskikh titrovaniĭ. ***George Khagimash.*** *Bucharest, Institutul Politehnic, Buletinul*, v. 20, no. 1, Jan.-Mar. 1958, p. 51-52.

6390* Recording Spectrofluorometers: Two New Designs and Their Evaluation. The construction and performance of two new spectrofluorometers are described and compared with a commercially available instrument. ***Joseph W. Goldzieher, William S. Bauld, Lewis L. Engel, and Morris L. Givner.*** *Canadian Journal of Biochemistry and Physiology*, v. 38, Mar. 1960, p. 233-243.

6391* Separation of Carbohydrate Derivatives by Gas-Liquid Partition Chromatography. Gas-liquid partition chromatography was used to separate all of the possible tetra- and tri-*O*-methyl ethers of methyl α- and β-*D*-glucopyranoside. ***C. T. Bishop and F. P. Cooper.*** *Canadian Journal of Chemistry*, v. 38, Mar. 1960, p. 388-395.

6392* Microdetermination of Calcium in Waters. A study of the aggressive action of certain waters on lime-based materials such as cements, mortars, asbestos cements, and some rocks was conducted by micro- and submicrodetermination of minima of Ca contents of 0.025 mg and 0.004 mg or 4 gammas, respectively. The reproducibility of the method is ± 10%. *(In French.)* Microdosage du calcium dans les eaux. ***Edm. Leclerc and G. Van Beneden.*** *Centre Belge d'Etude et de Documentation des Eaux, Bulletin Mensuel No.* 108, Dec. 1959, p. 317-319.

6393 Glass Paper Aids Chromatography. Glass paper chromatography technique gives good separations on small samples, allows use of corrosive reagents to develop spots. *Chemical and Engineering News*, v. 38, no. 8, Feb. 22, 1960, p. 51 + 2 pages.

6394* The Inorganic Constituents in Australian Coals. II. Combined Acid-Digestion-Low-Temperature Oxidation Procedure for Determination of Total Mineral-Matter Content, Water of Hydration of Silicate Minerals and Composition of Carbonate Minerals. ***H. R. Brown, R. A. Durie, and H. N. S. Schafer.*** *Fuel*, v. 39, no. 1, Jan. 1960, p. 59-70.

6395* A Method of Analysis of Oxygen Isotopes in Orthophosphate—Its Use in the Measurement of Paleotemperatures. Procedure for the determination of the O^{18}/O^{16} ratio in orthophosphate and condensed phosphate involves purification and precipitation of the phosphate as $BiPO_4$. The phosphate O is then released using BrF_3, purified, and analyzed by mass spectrometry. If this method could be used to establish a relationship between growth temperature and isotopic abundance of O in the carbonates and phosphates of modern shells, then by an analysis of fossil shells, it might be possible to obtain accurate values of temperature in former geological time. ***A. P. Tudge.*** *Geochimica et Cosmochimica Acta*, v. 18, nos. 1-2, Jan. 1960, p. 81-93.

6396* Polarographic Estimation of Cadmium in Presence of Nickel, Cobalt and Bismuth. ***H. C. Saraswat.*** *Indian Academy of Sciences, Proceedings*, v. 51, sec. A, no. 1, Jan. 1960, p. 34-40.

6397* The Determination of Sulphur Trioxide and Sulphur Dioxide in Flue Gases. A compact portable apparatus and a simplified technique have been developed. The sensitive turbidimetric procedure evolved for sulfur trioxide requires at most a 10 l. sample of flue gas, and determinations may be made at an average rate of one every 15 to 20 min. ***R. S. Fielder, P. J. Jackson, and E. Raask.*** *Institute of Fuel, Journal*, v. 33, Feb. 1960, p. 84-89 + 1 plate.

6398* Determination of Oxygen in Steel. Melt-Extraction Method in an Argon Stream. The conventional melt extraction method for the determination of O in steel was modified by having the test samples degassed in an atmosphere of Ar gas, instead of merely in a vacuum. At the same time, the unit weight of a sample was reduced to 0·5 g. The liberated carbon monoxide is transformed by a suitable oxidizing agent into carbon dioxide, and then titrated electrolytically. By this means it was possible to test a substantially greater number of samples in one graphite crucible in immediate succession. ***K. Abresch and H. Lemm.*** *Metal Treatment and Drop Forging*, v. 27, Jan. 1960, p. 28-34.

6399 Carrier Gas and Sensitivity in Gas Chromatography. When the filament temperature of the thermal conductivity detector is held constant, He carrier gas is nearly ten times as sensitive as Ar. ***E. M. Fredericks, M. Dimbat, and F. H. Stross.*** *Nature*, v. 184, Sept. 5, 1959, p. 54.

6400 Influence of Gold in a Mercury Electrode on Certain Electrode Processes. The presence of Au in the electrode greatly influences both cathodizing and anodizing processes of Zn. ***Wiktor Kemula, Zenon Kublik, and Zbigniew Galus.*** *Nature*, v. 184, Sept. 5, 1959, p. 56-57.

6401 Separation of Uranium by Reversed Phase-Partition Chromatography. Method involves use of tributyl phosphate on a partition chromatographic column. ***A. G. Hamlin and B. J. Roberts.*** *Nature*, v. 185, Feb. 20, 1960, p. 527-528.

6402 Colorimetric Determination of Amino-Acid Concentration. The amino-acid solutions are incubated with cupric orthophosphate in suspension. The resulting solution contains Cu in proportion to the total molarity of amino-acids. The Cu is determined colorimetrically using sodium diethyl dithio carbamate as the reagent. ***W. A. Vincent.*** *Nature*, v. 185, Feb. 20, 1960, p. 530.

6403* Polarography on Platinum in Hydrochloric Solutions. A survey of all the factors influencing the polarographic characteristics of Pt. *(In Italian.)* Polarografia del platino in soluzioni cloridriche. ***Francesco Pantani and Piergiorgio Desideri.*** *Ricerca Scientifica*, v. 29, Dec. 1959, p. 2598-2604.

6404* Spectrophotometric Analysis of Vanadium in Petroleum Ash and in Corrosion Products of Refractory Alloys. A spectrophotometric method was employed, using "aluminon" as the reagent and eliminating the effect of certain interfering ions (Fe^{III}, Cr^{VI}, Mo^{VI}) by reduction with ascorbic acid. With this procedure it is possible to determine with sufficient accuracy the amount of V in solution for quantities in the order of 7 γ/cm^3, and to determine a few units per thousand of V in the original products. *(In Italian.)* Analisi spettrofotometrica del vanadio nelle ceneri di petrolio e nei prodotti di corrosione delle leghe refrattarie. ***Maria Lucco Borlera.*** *Rivista dei Combustibili*, v. 13, no. 12, Dec. 1959, p. 893-900.

6405* The Infrared and Raman Spectra of the Pentafluoroethyl Halides. The infrared spectra of the pentafluoroethyl halides have been investigated in the gaseous state with double-beam prism spectrometers using NaCl and CaF_2 prisms, and the Raman spectra of the compounds have been obtained for both the gaseous and liquid state. Depolarization ratios were determined for the Raman spectra of the liquids. An empirical correlation has been observed between the amount of overlap of the F and halogen atoms on the two end groups of the molecule and the contribution of the F-halogen interaction to the barrier height. ***O. Risgin and R. C. Taylor.*** *Spectrochimica Acta*, 1959, no. 12, p. 1036-1050.

6406* The Infrared Absorption Characteristics of Ferroelectric Triglycine Sulfate. Absorption studies of glycine and triglycine sulfate and their deuterated analogs together with corresponding reflection and dichroic absorption data for variously oriented crystal sections of triglycine sulfate are reported. A comparison of the spectra of triglycine sulfate and triglycine selenate reveals differences in force constants and bonding of the sulfate and selenate ions. ***D. M. Dodd.*** *Spectrochimica Acta*, 1959, no. 12, p. 1072-1084.

6407 High Sensitivity Mass Spectrometry of the Rare Gases. A 60° sector type of mass spectrometer and associated sample preparation system adapted for ultrasensitive analysis

of rare gas isotopic abundances is described. ***Oliver A. Schaeffer.*** *U. S. Atomic Energy Commission, BNL-581* (T-161), Dec. 1959, 12 pp. (UF767 Un3.1bn Contin.)

6408 Liquid Scintillation Spectrometry for the Analysis of Zr^{95}-Nb^{95} Mixtures and Coincidence Standardization of These Isotopes. ***J. Donald Ludwick.*** *U. S. Atomic Energy Commission, HW-61728,* Aug. 31, 1959, 21 pp. (UF767 Un3.1hw Contin.)

6409 Evaluation of Uranium Isotopic Analysis Using a 4-Meter Direct-Reading Spectrograph. A hollow cathode discharge source and a 4-meter, direct-reading, high-resolution spectrograph were combined to measure the isotopic U lines at 4244 A. ***Ted Lee, Owen P. Killeen, and S. A. MacIntyre.*** *U. S. Atomic Energy Commission, K-1427,* Feb. 11, 1960, 26 pp. (UF767 Un3.1k Contin.)

6410 A Study of Spectrophotometric Methods for the Determination of Osmium. In Method A, Os is first oxidized to the octavalent state and the osmium tetroxide which is formed is selectively extracted with chloroform. In Method B, the Os is oxidized to osmium-tetroxide and then extracted with chloroform. Diphenylcarbazide is then added to the organic extract. In Method C, the Os-diphenylcarbazide complex is formed in an aqueous acid solution at 65 C and the complex is then extracted with chloroform. ***G. Goldstein.*** *U. S. Atomic Energy Commission, ORNL-2862,* Jan. 20, 1960, 71 pp. (UF767 U3o Contin.)

6411 Oak Ridge National Laboratory Master Analytical Manual. Section 9, Process Methods; Supplement 1. *U. S. Atomic Energy Commission, TID-7015,* Sept. 1958 and Nov. 1959, Sections individually paged. (UF767 Un3ti Contin.)

6412* Combustion Calorimetry With Fluorine: Constant Pressure Flame Calorimetry. Instruments and methods were developed and are described for the measurement of heats of reaction between fluorine and other gaseous materials. ***G. T. Armstrong and R. S. Jessup.*** *U. S. National Bureau of Standards, Journal of Research, Section A, Physics and Chemistry,* v. 64A, no. 1, Jan.-Feb. 1960, p. 49-59.

6413* Omega Chrome Black Blue G as a Colorimetric Reagent for the Microdetermination of Various Cations. ***A. A. Abd El Raheem, Abdel Aziz Amin, and Farouk A. Osman.*** *Zeitschrift für Analytische Chemie,* v. 171, no. 6, 1960, p. 420-431.

See also: **6841** (continuous boiling point analyzer); **7157** (advances in mass spectroscopy); **7158** (advances in spectroscopy).

CHEMISTRY—INORGANIC AND GENERAL

6414 Preparation of Tetraboron Silicide, B_4Si. B_4Si is prepared by heating the elements in an inert atmosphere at temperatures not exceeding 1370 C. Above this temperature, B_4Si is thermally unstable. It is highly oxidation resistant due to the formation of a protective boron-silicon-oxygen coating which first forms upon exposure of the material to air at elevated temperatures. ***Ervin Colton.*** *American Chemical Society, Journal,* v. 82, Feb. 20, 1960, p. 1002.

6415 Studies in the System CaO-Al_2O_3-SiO_2-H_2O. II. The System $CaSiO_3$-H_2O. A study of the system $CaSiO_3$-H_2O was undertaken to determine the stabilities of xonotlite and lower-temperature calcium silicate hydrates as a function of temperature and pressure and their relationship to the formation of wollastonite. ***Dean A. Buckner, Della M. Roy, and Rustum Roy.*** *American Journal of Science,* v. 258, no. 2, Feb. 1960, p. 132-147.

6416* The Reactions of Active Nitrogen With Cyanogen and CN Radicals. Cyanogen is destroyed by active N_2 at temperatures of 80 to 400 C, and N_2 pressures of 0.34 to 3.1 mm, with the formation of polymer. At 400 C and sufficiently high flow rates of cyanogen, a constant amount is destroyed, which apparently corresponds to practically complete consumption of the available N atoms. The formation of CN radicals in the reaction of cyanogen with active N was established by the production of HCN and CH_3CN when H or methane was added to the reaction mixture. ***Catherine Haggart and C. A. Winkler.*** *Canadian Journal of Chemistry,* v. 38, Mar. 1960, p. 329-333.

6417 The Phosphonitrilic Derivatives—Aromatics Without Carbon. Describes the relevance of some new theoretical ideas to phosphonitrilic derivatives, a series of inorganic polymers with many features in common with organic aromatic compounds. ***N. L. Paddock.*** *Research Applied in Industry,* v. 13, Mar. 1960, p. 94-100.

6418* Radiochemical, Spectrophotometric and Chromatographic Investigations on Iron Phosphate Complexes. Studies on the constitution of complexes of Fe(III) with metaphosphate, orthophosphate, and pyrophosphate ions indicate that the complexes are stable in HCl solutions at ph $>$ 1.6, while splitting up into their component ions in solutions of higher acidity. *(In Italian.)* Indagini radiochimiche, spettrofotometriche e cromatografiche su complessi ferri-fosforici. ***Umberto Belluco, Loris Busulini, and Renato Barbieri.*** *Ricerca Scientifica,* v. 29, Nov. 1959, p. 2329-2336.

6419 Preparation of Yttrium Fluoride Using Fluorine. Preparation of a low oxygen content yttrium fluoride using commercial fluorine gas. Purity of yttrium fluoride prepared using hydrogen fluoride gas could be improved by treating it with fluorine (1) at a temperature of 600 C under pressures in the range of 20-25 psig or, to a lesser degree, (2) at 25 C and one atmosphere pressure. ***R. L. Tischer and G. Burnet.*** *U. S. Atomic Energy Commission, IS-8,* June 1959, 41 pp. (UF767 Un3.1isu Contin.)

6420* Energy Levels and Spectrum of Neutral Helium (^1He_I). ***William C. Martin.*** *U. S. National Bureau of Standards, Journal of Research, Section A, Physics and Chemistry,* v. 64A, no. 1, Jan.-Feb. 1960, p. 19-28.

6421* Studies of Beryllium Chromite and Other Beryllia Compounds With R_2O_3 Oxides. Reactions between BeO and R_2O_3 oxides at high temperatures were studied. Compound formation was observed between BeO and the following oxides: B_2O_3, Al_2O_3, Ga_2O_3, Y_2O_3, La_2O_3, and Cr_2O_3. Optical and X-ray data are given for all reaction products. ***C. E. Weir and A. Van Valkenburg.*** *U. S. National Bureau of Standards, Journal of Research, Section A, Physics and Chemistry,* v. 64A, no. 1, Jan.-Feb. 1960, p. 103-106.

CHEMISTRY—ORGANIC

6422 Synthesis of Some New Six-membered Organometallic Ring Systems. The 1-stanna-4-silacyclohexane, 1-stanna-4-germanacyclohexane, and 1,4-distannacyclohexane ring systems were synthesized by means of addition reactions involving diphenyltin dihydride and the appropriate unsaturated reactants. Complexes of these compounds with several cyclic solvents were isolated. ***Malcolm C. Henry and Jan G. Noltes.*** *American Chemical Society, Journal,* v. 82, Feb. 5, 1960, p. 561-563.

6423 A Study of the Selenium Dehydrogenation of Guaiol and Related Compounds. Selenium as a Hydrogen Transfer Agent. Se dehydrogenation of guaiene, two isomeric dihydroguaines, tetrahydroguaiene and guaiol in *m*-terphenyl as solvent for relatively short reaction times resulted in mixtures of S-guaiazulene (1,4-dimethyl-7-iso-propylazulene) and Se-guaiazulene (2,4-dimethyl-7-iso-propylazulene). In experiments with guaiene, it was shown that considerably more guaiazulene was obtained than could be accounted for by the sum of the Se which disappeared from the solid phase and the hydrogen selenide evolved. ***William T. House and Milton Orchin.*** *American Chemical Society, Journal,* v. 82, Feb. 5, 1960, p. 639-642.

6424 Synthesis of Primary 1,2-Diamine by Hydrogenation of α-Aminonitriles. Successful low pressure reduction of unsubstituted α-aminonitriles in alcoholic HCl in the presence of platinum oxide is reported. ***Morris Freifelder and Richard B. Hasbrouck.*** *American Chemical Society, Journal,* v. 82, Feb. 5, 1960, p. 696-698.

6425 The Solvolysis of Aspirin Anhydride. Aspirin anhydride hydrolyzes to aspirin with no evidence of prior or concomitant hydrolysis of the acetyl linkages and with no evidence of H ion accelerated hydrolysis. Aspirin anhydride is hydrolyzed by water, acetate and hydroxyl ions; undissociated acetic acid inhibits hydrolysis. Dielectric constant and temperature effects on the kinetics were studied. ***Edward R. Garrett.*** *American Chemical Society, Journal,* v. 82, Feb. 5, 1960, p. 711-718.

6426 Reactions of Phosphorus Compounds. II. A New Type of Oxidizing Agent—Trichloroacetamides. Phosphites and phosphines react with N,N-disubstituted trichloroacetamides to give trichlorovinylamines and the corresponding quadruply-connected phosphorus compound. ***A. J. Speziale and R. C. Freeman.*** *American Chemical Society, Journal,* v. 82, Feb. 20, 1960, p. 903-909.

6427 The Reactions of Enamines. I. N,N-Disubstituted-1,2,2-trichlorovinylamines. ***A. J. Speziale and R. C. Freeman.*** *American Chemical Society, Journal,* v. 82, Feb. 20, 1960, p. 909-917.

6428* Perfluoroalkyl Arsenicals. I. The Preparation of Alkyl Perfluoroalkyl Arsenicals. II. The Preparation and Properties of Aryl Perfluoroalkyl Arsenicals. ***W. R. Cullen.*** *Canadian Journal of Chemistry,* v. 38, Mar. 1960, p. 439-451.

6429 The Structures of 2 Phenylisioisatogen and 2-Phenylisatogen *N*-Oxime. ***Jack L. Pinkus, Theodore Cohen, M. Sundaralingam, and G. A. Jeffrey.*** *Chemical Society, Proceedings,* 1960, Feb., p. 70-71.

6430 The Reaction of Azulenes With Trifluoroacetic Anhydride. The nucleophilic character of azulene is such that the hydrocarbon reacts rapidly with trifluoroacetic anhydride in carbon tetrachloride at room temperature to give a 91.5% yield of 1-trifluoroacetylazulene. ***Arthur G. Anderson, Robert Griffin Anderson, and Lanny L. Replogle.*** *Chemical Society, Proceedings,* 1960, Feb., p. 72.

6431 The Reaction of Cyclohexene With Photo-Activated Carbonyl Compounds. ***P. de Mayo, J. B. Stothers, and W. Templeton.*** *Chemical Society, Proceedings,* 1960, Feb., p. 72-73.

6432 Calycanthine: The Structure of the Alkaloid and Its Degradation Product, Calycanine. ***R. B. Woodward, et al.*** *Chemical Society, Proceedings,* 1960, Feb., p. 76-78.

6433* Metal Carbonyls and Related Compounds as Catalytic Intermediates in Organic Syntheses. The following types of reactions among others were discussed: Exchange of carbonyl in organic molecules with gaseous CO, addition of CO to organic compounds; this includes the addition of CO alone or with other molecules such as H_2, H_2O, or ROH, hydrogenation, and the isomerization of olefins. These reactions are carried out in the presence of metal carbonyls, usually at 100-200 atm and 100-200 C. *(In Italian.)* Metallo-carbonili e composti analoghi come intermedi catalitici nelle sintesi organiche. ***H. W. Sternberg, R. Markby, and I. Wender.*** *Chimica e l'Industria,* v. 42, Jan. 1960, p. 41-51.

6434 The Gaseous Oxidation of Secondary Aliphatic Amines. The gaseous oxidation of dimethylamine and diethylamine was studied between 240 and 300 C. The reaction has some autocatalytic character, but the similarity of the dependence of the initial and maximum oxidation rates on reactant concentrations suggests that chain-branching is largely suppressed. In oxygen-deficient mixtures, the main products are primary amines, ammonia and aldehydes; in oxygen-rich systems, the yields of N bases are lower and small amounts of oxides of N are formed. ***C. F. Cullis and D. J. Waddington.*** *Faraday Society, Transactions,* v. 55, Dec. 1959, p. 2069-2076.

6435* Heterocyclic Compounds. XV. Synthesis of α-Pyridylindoles. The synthesis of some of the methyl-substituted α-pyridylindoles by the application of the Fischer indole reaction. ***V. K. Lakshmanan.*** *Indian Academy of Sciences, Proceedings,* v. 51, sec. A, no. 1, Jan. 1960, p. 41-47.

6436* The Formation of Δ^9-Unsaturated Fatty Acids. Extracts prepared from anaerobically grown yeast with the aid of the Hughes, press catalyze the desaturation of palmitic to palmitoleic acid and of stearic to oleic acid. The cofactors required for the conversion are coenzyme A, adenosine triphosphate, reduced triphosphopyridine nucleotide, and Mg^{++}. Molecular oxygen is essential for the reaction and cannot be replaced by artificial electron acceptors. ***D. K. Bloomfield and Konrad Bloch.*** *Journal of Biological Chemistry,* v. 235, no. 2, Feb. 1960, p. 337-345.

6437 α-Oximino Ketones. IV. The "Normal" and "Abnormal" Beckmann Rearrangements. The Beckmann rearrangement of α-oximino ketones possessing the *anti* configuration, whether brought about by acid chlorides like PCl_5 or thionyl chloride, by strong acids like H_2SO_4 or trifluoroacetic, or by acylating agent and base, has been shown to proceed "abnormally", that is by cleavage to a nitrile and a carboxylic acid. If an amide product is obtained, it is always that which arises from hydrolysis of the nitrile initially formed. It is proposed that the term "second order" be retained to describe this type of Beckmann rearrangement, which is characterized by shift of an electron pair only. ***Arthur F. Ferris.*** *Journal of Organic Chemistry,* v. 25, Jan. 1960, p. 12-18.

6438 Addition Reactions of Mixtures of Bromine and Chlorine. Mixtures of Br and Cl have been used as sources of bromine chloride for the synthesis of bromochlorides from cyclohexene, styrene, ethylene, *trans*-cinnamic acid, *cis*- and *trans*-stilbene, and diphenylacetylene. ***Robert E. Buckles, Joseph L. Forrester, Robert L. Burham, and Thomas W. McGee.*** *Journal of Organic Chemistry,* v. 25, Jan. 1960, p. 24-26.

6439 Studies in the Juglone Series. IV. The Addition of Aniline and Toluene-*p*-thiol to 5-Substituted 1,4-Naphthoquinones. ***J. W. MacLeod and R. H. Thomson.*** *Journal of Organic Chemistry,* v. 25, Jan. 1960, p. 36-42.

6440 Heterocyclic Vinyl Ethers. XVII. Benzo-1,4-oxathiadiene-2-aldehyde, 2-Methylbenzo-1,4-oxathiadiene and 3-Methylbenzo-1,4-oxathiadiene. The electrophilic formulation of benzo-1,4-oxathiadiene gives benzo-1,4-oxathiadiene-2-aldehyde. The synthesis of 2-methyl- and 3-methylbenzo-1,4-oxathiadiene, as well as derivatives of these new heterocycles, is described. ***William E. Parham and Gordon L. Willette.*** *Journal of Organic Chemistry,* v. 25, Jan. 1960, p. 53-56.

6441 Reaction of 2-Phenylquinoxaline and of 2,3-Diphenylquinoxaline With Dimethyl Acetylenedicarboxylate. 2,3-Diphenylquinoxaline reacts with dimethyl acetylenedicarboxylate in methanol to give a yellow product which consists of 1 mole each of 2,3-diphenylquinoxaline, dimethyl acetylenedicarboxylate, and methanol. This product is assigned the structure 1-(1,2-dicarbomethoxyvinyl)-2,3-diphenyl-2-methoxy-1,2-dihydroquinoxaline in neutral or basic solution in methanol, while in acidic methanol it exists as 1-(1,2-dicarbomethoxyvinyl)-2,3-diphenylquinoxalinium cation. 2-Phenylquinoxaline reacts similarly to give a product which after long exposure to the atmosphere was isolated as 1-(1,2-dicarbomethoxyvinyl)-3-phenyl-2-hydroxy-1,2-dihydroquinoxaline. ***Erling Grovenstein, Jr., William Postman, and James W. Taylor.*** *Journal of Organic Chemistry,* v. 25, Jan. 1960, p. 68-73.

6442 Aluminum Chloride-Catalyzed Opening of the Steroidal Sapogenin Spiroketal System. Several representative steroidal sapogenins have been converted to the corresponding dihydrosapogenins employing the lithium aluminum hydride-aluminum chloride reagent. Dihydro derivatives of 11 α-hydroxytigogenin, markogenin, and three previously described dihydrosapogenins were prepared. ***George R. Pettit and William J. Bowyer.*** *Journal of Organic Chemistry,* v. 25, Jan. 1960, p. 84-86.

6443 Steroidal Aldosterone Blockers. III. The syntheses and biological activities of several new steroidal 17-spirolactones are presented. Oxygenation of position 11 in the steroid nucleus produces some increase of aldosterone blocking activity and this activity is further enhanced by the additional introduction of 9-α-fluoro substituent. ***Edward A. Brown, Robert D. Muir, and John A. Cella.*** *Journal of Organic Chemistry,* v. 25, Jan. 1960, p. 96-99.

6444 Effects of Perfluoroalkyl Groups on Adjacent Functions. The adjacency of a perfluoroalkyl group can affect the stability of intermediate reaction products in such an adverse way as to render impractical some conventional reactions. Alde-

hydes and ketones so fluorinated react with diazomethane to give the expected oxides, but these are cleaved by hydrogen to give secondary and tertiary alcohols, instead of primary and secondary alcohols. Pyrolysis of *N,N'*-di(trifluoroacetyl)hydrazine and *N*-benzenesulfonyl-*N'*-trifluoroacetylhydrazine did not give trifluoroacetaldehyde, but its pyrolysis products, carbon monoxide and fluoroform. ***Richard H. Groth.*** *Journal of Organic Chemistry*, v. 25, Jan. 1960, p. 102-105.

6445 Addition of Mercuric Fluoride to Fluoroethylenes. A convenient synthesis of polyfluoroethylmercurials was found in the addition of mercuric fluoride to fluoroethylenes in the presence of a solvent. Volatile bis(polyfluoroethyl)mercury compounds are formed directly and in good conversion. Bis-(1,2,2,2-tetrafluoroethyl)mercury and bis(2,2,2-trifluoroethyl)-mercury were characterized. ***C. G. Krespan.*** *Journal of Organic Chemistry*, v. 25, Jan. 1960, p. 105-107.

6446 The Rhodium-Catalyzed Hydrogenation of Ethyl-5,6-benzocoumarin-3-carboxylate. Room temperature, low pressure hydrogenation of ethyl 5,6-benzocoumarin-3-carboxylate employing rhodium (5%) on alumina as the catalyst afforded a decalin derivative, ethyl β-(α-decalyl)isobutyrate. ***Kenneth J. Liska and Leroy Salerni.*** *Journal of Organic Chemistry*, v. 25, Jan. 1960, p. 124-126.

6447 Syntheses Utilizing γ-Cyano-γ-phenylpimelonitrile. Procedures for obtaining derivatives from γ-cyano-γ-phenylpimelonitrile. ***C. F. Koelsch.*** *Journal of Organic Chemistry*, v. 25, Feb. 1960, p. 164-174.

6448 Acid-Catalyzed Rearrangements of the γ-(Methylanilino)lactone of *cis*-β-(*p*-Bromobenzoyl)-β-methylacrylic Acid, and of *trans*-β-(*p*-Bromobenzoyl)acrylic Methylanilide, to Oxindoles. Structures of the acid-catalyzed rearrangement products of aroylacrylic "methylanilides" to phenacyloxindoles were shown by synthesis through condensations of *N*-methylization with appropriate aryl ketones followed by dehydrations and reductions. The properties and structures of the intermediate phenacylidineoxindoles are considered. ***Robert E. Lutz and Carroll T. Clark.*** *Journal of Organic Chemistry*, v. 25, Feb. 1960, p. 193-196.

6449 Spectrophotometric Studies of Some 2,4-Dinitrophenylhydrazones. III. Taft and Hammett Relationships. Ultraviolet and visible spectra of 21 *m*- and *p*-substituted aromatic 2,4-dinitrophenylhydrazones (DNP's) and 23 α-substituted acetaldehyde and acetone DNP's in chloroform and in alcoholic base were determined. ***Louis A. Jones and C. Kinney Hancock.*** *Journal of Organic Chemistry*, v. 25, Feb. 1960, p. 226-231.

6450 Organosilicon Compounds. I. Synthesis of Some Long-Chain Tetraalkylsilanes. II. 1,1-Disubstituted Silacyclohexanes. Many of the silanes synthesized exhibit extremely wide liquidus range and may be considered representative of a new class of thermally stable fluids. Physical properties of the 1,1-dialkylsilacyclohexanes are presented. I. ***Harold Rosenberg, James D. Groves, and Christ Tamborski.*** II. ***Christ Tamborski and Harold Rosenberg.*** *Journal of Organic Chemistry*, v. 25, Feb. 1960, p. 243-248.

6451 Synthesis of 2-Phenyltriphenylene and 2,6,10-Trimethyltriphenylene. ***D. David Lawson and Charles M. Buess.*** *Journal of Organic Chemistry*, v. 25, Feb. 1960, p. 272-273.

6452 Nuclear Alkylation of Salts of Naphthols and Anthranol. Alkylation with benzyl chloride of the Li salt of α-naphthol suspended in toluene gives in addition to the phenolic products 2,2-dibenzyl-1(2)-naphthalenone and a tribenzyl ketone, presumably 2,2,4-tribenzyl-1(2)-naphthalenone. ***David Y. Curtin, Richard C. Tuites, and Douglas H. Dybvig.*** *Journal of Organic Chemistry*, v. 25, Mar. 1960, p. 155-158.

6453 Radiolysis of *n*-Paraffins: Mechanism of Formation of the Heavy Products. All major products and nearly all minor ones evidently originate from simple bond-breaking processes. ***C. D. Wagner.*** *Journal of Physical Chemistry*, v. 64, Feb. 1960, p. 231-237.

6454* Intermolecular Association in Organic Nitriles; the CN Dipole-Pair Bond. Intermolecular interactions involving the CN groups in organic nitriles were investigated through comparison of the physical properties of nitriles and other organic liquids. Evidence is presented that H bonding is not a significant factor in these interactions. The energy of interaction between two CN groups is high; it is proposed to call this interaction a CN dipole-pair bond, by analogy with the H bond. Equations are derived for energies of interaction between dipoles separated by relatively short distances. ***A. M. Saum.*** *Journal of Polymer Science*, v. 42, Jan. 1960, p. 57-66.

6455* Solubilization of Long Chain Alkyl Compounds by a Non-Ionic Surfactant, and Clouding Formation Observed in Such Systems. To an aqueous solution of methoxy-polyoxyethylene decyl ether (a nonionic surfactant), various amounts of a long chain alkyl compound such as hydrocarbon, alcohol, acid, amine or chlorohydrocarbon, were added. Saturation amounts of solubilization, clouding points and phase separations in these systems were observed and the result is represented diagrammatically. ***T. Nakagawa and K. Tori.*** *Kolloid-Zeitschrift*, v. 168, no. 2, Feb. 1960, p. 132-139.

6456 Potential Barrier of Phenol From Its Microwave Spectrum. ***Takeshi Kojima.*** *Physical Society of Japan, Journal*, v. 15, Feb. 1960, p. 284-287.

6457 A Short Course of Organic Chemistry. This book is designed for a one-semester course in organic chemistry and is meant primarily for students majoring in fields other than chemistry. Emphasis is on applications of organic chemistry rather than on technical detail. ***John E. Leffler.*** 201 pp. 1959. The MacMillan Co., New York. (QD253 L52s)

6458* Iodine Complexes in Inert Solvents. IV. The Reaction Between Diethyl Ether and Iodine in the Pure Solvent or in Inert Solvents. Spectrophotometric measurements of the rate of decoloration of brown diethyl ether-iodine solutions are reported. The addition of sodium iodide increases the rate of decoloration fivefold. ***P. A. D. de Maine.*** *Spectrochimica Acta*, 1959, no. 12, p. 1058-1062.

6459* Preparation of Pyrylium Salts by Olefin Diacylation. The Two Pyrylium Salts Formed in Amylene Diacetylation With Various Catalysts. ***A. T. Balaban and C. D. Nenitzescu.*** *Tetrahedron Letters*, 1960, no. 2, Feb., p. 7-10.

6460* Investigation of the Pyrolytic Decarboxylation of Carboxylic Acids With ^{14}C. Mechanism of the Formation of Camphor From Homocamphoric Acid. ***L. Ötvös and L. Noszkó.*** *Tetrahedron Letters*, 1960, no. 2, Feb., p. 19-22.

6461* The Deuterium Isotope Effect in the Permanganate Oxidation of Aromatic Trifluoromethyl Alcohols. Phenyl trifluoromethyl cabinols are oxidized by aqueous alkaline permanganate to the corresponding ketones. The kinetic isotope effect of unusual size for the reaction of the 1-deuterio analogs of these compounds is reported. ***R. Stewart and R. Van der Linden.*** *Tetrahedron Letters*, 1960, no. 2, Feb., p. 28-30.

6462* The Structure of Metagenin. Structure determined to be 25D,5β-spirostane-2β,3β,11α-triol. ***Ken'ichi Takeda and Kaname Hamamoto.*** *Tetrahedron Letters*, 1960, no. 3, Feb., p. 1-8.

See also: **6820** (electrochemical fluorination).

CHEMISTRY—PHYSICAL

6463* A Three-Dimensional Analysis of the Crystal Structure of *p*-Benzoquinone. ***James Trotter.*** *Acta Crystallographica*, v. 13, pt. 2, Feb. 10, 1960, p. 86-95.

6464 The D_2O-H_2O Solvent Effect on a Complex Ion Equilibrium. The change in solvent from H_2O to D_2O increases the equilibrium quotient for the reaction $(NH_3)_5CoOH_2^{+++} + Cl^- = (NH_3)_5ClOCl^{++} + H_20$ by the factor 1.5. Comparisons are made of the effect observed here with that of the corresponding reaction, but with OH^- replacing Cl^-. ***Henry Taube.*** *American Chemical Society, Journal*, v. 82, Feb. 5, 1960, p. 524-526.

6465 The Nature of the Rate-Determining Step in Deoxymercuration. It is concluded that the rate-determining step in deoxymercuration is the conversion of the protonated substrate to the mercuric olefin complex, and that the α-isomer has the *trans* configuration. Other pertinent findings are discussed in terms of this mechanism. ***Maurice M. Kreevoy and Frances R. Kowitt.*** *American Chemical Society, Journal,* v. 82, Feb. 5, 1960, p. 739-745.

6466 Photoisomerization of 5-Hexen-2-one. The photochemistry of 5-hexen-2-one was studied in the vapor phase in the temperature range from 27 to 139 C at 3130 Å, and also with radiation from an unfiltered Hg arc. ***R. Srinivasan.*** *American Chemical Society, Journal,* v. 82, Feb. 20, 1960, p. 775-778.

6467 Acid Ionization Constants of Alcohols. II. Acidities of Some Substituted Methanols and Related Compounds. The acid ionization constants of twelve simple alcohols were determined by a conductivity procedure for dilute solutions. ***P. Ballinger and F. A. Long.*** *American Chemical Society, Journal,* v. 82, Feb. 20, 1960, p. 795-798.

6468 Vapor Pressure of Chromium(II) Bromide. Thermodynamic properties of the monomeric and dimeric forms were evaluated relative to the solid. ***R. J. Sime and N. W. Gregory.*** *American Chemical Society, Journal,* v. 82, Feb. 20, 1960, p. 800-801.

6469 The Thermal Decomposition of Thiolsulfonates. The thiolsulfonates $RSO_2SCH_2C_6H_5$, where R = $(C_6H_5)_2CH$- or $C_6H_5CH_2$-, undergo thermal decomposition in inert solvents with essentially quantitative evolution of SO_2 and the formation of varying amounts of $RSCH_2C_6H_5$, RH, stilbene, dibenzyl disulfide, and R-R. ***John L. Kice, Fred M. Parham, and Robert M. Simons.*** *American Chemical Society, Journal,* v. 82, Feb. 20, 1960, p. 834-842.

6470* An Investigation of the Effect of Ultrasonic Waves on the Rates of Hydrolysis of Procaine and Butethamine Hydrochlorides. The rates of insonated samples were compared to the rates of noninsonated samples under similar conditions. No significant differences were noted other than those attributable to slight increases in the over-all temperatures of the insonated solutions. ***G. D. Fenn and P. F. Belcastro.*** *American Pharmaceutical Association, Journal (Scientific Ed.),* v. 49, Feb. 1960, p. 105-107.

6471* The Trypsin-Catalyzed Hydrolysis of Benzoyl-*L*-Arginine Ethyl Ester. I. The Kinetics in Dioxane-Water Mixtures. The rate of hydrolysis was measured in dioxane-water mixtures containing up to 88 vol. % dioxane. ***Tadashi Inagami and Julian M. Sturtevant.*** *Biochimica et Biophysica Acta,* v. 38, no. 1, Feb. 12, 1960, p. 64-79.

6472 Thermodynamic Properties of Binary Mixtures of Benzene, Cyclohexane and Carbon Tetrachloride. ***R. P. Rastogi and R. K. Nigam.*** *Faraday Society, Transactions,* v. 55, Dec. 1959, p. 2005-2012.

6473 The Heats of Combustion, Solution and Ionization of Lactic Acid. ***G. Saville and H. A. Gundry.*** *Faraday Society, Transactions,* v. 55, Dec. 1959, p. 2036-2038.

6474 Determination of the Dissociation Constants and Heats of Formation of Molecules by Flame Photometry. VI. Stabilities of MnO and MnOH and Their Mechanisms of Formation. ***P. J. Padley and T. M. Sugden.*** *Faraday Society, Transactions,* v. 55, Dec. 1959, p. 2054-2061 + 1 plate.

6475 The Pyrolysis of Metal Alkoxides. II. Kinetic Studies on Zirconium Tetra-*Tert.*-Amyloxide. The thermal decomposition was studied in clean glass at temperatures between 208-247 C. Characteristic sigmoid pressure against time curves were obtained, corresponding to a chain mechanism. The results conformed to a mechanism involving the hydrolysis of the zirconium *tert.*-alkoxide by water produced in the dehydration of the *tert.*-alcohol. ***D. C. Bradley and M. M. Faktor.*** *Faraday Society, Transactions,* v. 55, Dec. 1959, p. 2117-2123.

6476 Chemisorption of Nitrogen on Iron Catalysts in Connection With Ammonia Synthesis. I. The Kinetics of the Adsorption and Desorption of Nitrogen. An account is given of experiments in which the adsorption rate of nitrogen is directly compared with the NH_3-synthesis rate, at the same temperature, pressure and N_2-coverage, this coverage being determined gravimetrically during ammonia synthesis. ***J. J. F. Scholten, P. Zwietering, J. A. Konvalinka, and J. H. de Boer.*** *Faraday Society, Transactions,* v. 55, Dec. 1959, p. 2166-2179.

6477 Palladium Catalysts. IX. Kinetic Studies. The inhibitory effects of products formed during Pd-on-carbon catalyzed hydrogenation reactions were investigated. ***Robert W. Meschke and Walter H. Hartung.*** *Journal of Organic Chemistry,* v. 25, Jan. 1960, p. 137-140.

6478 Kinetics of Oxidation-Reduction Reactions of Plutonium. The Reaction Between Plutonium(IV) and Titanium(III) in Perchlorate Solution. ***S. W. Rabideau and R. J. Kline.*** *Journal of Physical Chemistry,* v. 64, Feb. 1960, p. 193-196.

6479 Dispersion of Platinum on Supported Catalysts. Hydrogen chemisorption at saturation can be used to determine the specific surface area and an average crystal size for Pt highly dispersed on an alumina support in a range of dispersion not accessible to measurements by X-ray line broadening. ***Lawrence Spenadel and Michel Boudart.*** *Journal of Physical Chemistry,* v. 64, Feb. 1960, p. 204-207.

6480 Cryoscopic Studies in the Molten Bismuth-Bismuth Chloride System. A series of freezing-point depression measurements has been made in the metal-rich and salt-rich regions of the Bi-$BiCl_3$ system. ***S. W. Mayer, S. J. Yosim, and L. E. Topol.*** *Journal of Physical Chemistry,* v. 64, Feb. 1960, p. 238-240.

6481 The Measurement of the Heats of Sublimation of Zinc and Cadmium With the Mass Spectrometer. ***K. H. Mann and A. W. Tickner.*** *Journal of Physical Chemistry,* v. 64, Feb. 1960, p. 251-253.

6482 The Physical Properties of Certain Organic Fluorides. The boiling points, densities, and refractive indices were determined, and from these data the molar refractions, specific refractions, specific dispersions, (C-F) bond refractions and (CH_2) group refractions were calculated. ***W. A. T. Macey.*** *Journal of Physical Chemistry,* v. 64, Feb. 1960, p. 254-257.

6483 Solid-Vapor Equilibria for the Compounds Cd_3As_2 and $CdAs_2$. Dissociation pressures were measured by a dew-point technique and by a direct pressure method employing a quartz Bourdon gage. ***V. J. Lyons and V. J. Silvestri.*** *Journal of Physical Chemistry,* v. 64, Feb. 1960, p. 266-269.

6484* Use of Different Catalysts in Paraffin Oxidation. The presence of K compounds stabilizes the valence conditions of Mg in the induction period of oxidation of the hydrocarbons in the liquid phase, which leads to the prolongation of the induction period, but accelerates the formation of acids in the development stage of the reaction. The action of potassium permanganate was identical to the catalysis of an equimolar mixture of naphthenates of K and Mg. (*In Russian.*) Primenenie razlichnykh katalizatorov pri okislenii parafina. ***B. G. Freidin and B. K. Tsyskovskii.*** *Khimiia i Tekhnologiia, Toplivi Masel,* v. 4, no. 12, Dec. 1959, p. 25-29.

6485 Kinetic Study of Dextransucrase Based on the Langmuir Adsorption Isotherm. The dependence of reaction rate on concentration of the polysaccharide-synthesizing enzyme dextransucrase was studied. ***W. Brock Neely and C. F. Thompson.*** *Nature,* v. 184, Sept. 5, 1959, p. 64.

6486 Effect of Ultrasonic Insonation on the Carbon Tetrachloride-Water-Dissolved Helium System. ***Martin R. Levy.*** *Nature,* v. 185, Jan. 16, 1960, p. 159.

6487 The Nature of the Chemical Bond and the Structure of Molecules and Crystals: An Introduction to Modern Structural Chemistry. The principal innovations that have been made in the discussion of the theory of the chemical bond in this edition are the wide application of the electroneutrality principle and the use of an empirical equation for the evaluation of the bond numbers of fractional bonds from the observed bond lengths. A new theory of the structure of electron-deficient substances, the resonating-valence-bond theory, is described and used in the discussion of the boranes, ferrocene, and other substances. A detailed discussion of the valence-bond theory of the electronic structure of metals and intermetallic compounds

is also presented. ***Linus Pauling.*** 3rd. Ed. 644 pp. 1960. Cornell University Press, Ithaca, New York. (QD469 P28n3)

6488 Thermal Conductivity and Eucken Type Correction for Binary Mixtures of N_2 With Some Rare Gases. The thick-wire variant of the hot-wire method was used to measure the thermal conductivity of the binary mixtures N_2-He, N_2-Ne, N_2-Kr, and N_2-Xe at 30 and 45 C. ***A. K. Barua.*** *Physica,* v. 25, Dec. 1959, p. 1275-1286.

6489 The Definition of Entropy in Non-Equilibrium States. ***N. G. Van Kampen.*** *Physica,* v. 25, Dec. 1959, p. 1294-1302.

6490 Phase Transitions and Compressions of Solid CH_4, CD_4, and O_2. Solid CH_4 and CD_4 both show three phases and one triple point. The transitions appear to be of the second order, with rather large "regions of indifference". There are isotopic differences between the two methanes. At atmospheric pressure CH_4 shows only one of the transitions, at 20.5 K, while CD_4 has both, at 22.1 and 27.2 K. Pressure-volume relations for the three substances were obtained at various tempeartures. ***J. W. Stewart.*** *Physics and Chemistry of Solids,* v. 12, no. 2, Jan. 1960, p. 122-129.

6491 Non-Stoichiometric Hydrates. I. Sorption Equilibria and Kinetics of Water Loss for Ion-Exchanged Near-Faujasites. II. Some Heats and Entropies for Water and Ammonia in Ion-Exchanged Faujasites. III. The Relative Importance of Cations and of Anionic Framework in Determining the Energetics of Zeolitic Water. ***R. M. Barrer and G. C. Bratt.*** *Physics and Chemistry of Solids,* v. 12, no. 2, Jan. 1960, p. 130-166.

6492 The Proton in Chemistry. The topics discussed include the nature of acids and bases, measurement of acid-base strengths in aqueous solution acid-base equilibria, acid-base catalysis, and acid-base reactions. ***R. P. Bell.*** 223 pp. 1959. Cornell University Press, Ithaca, New York. (QD477 B41p)

6493* Thermodynamic Research on Metal Systems. XII. Miscibility Gap Determination by Computation Through the Thermodynamic Quantities for the Ternary Zn-Sn-Pb System. By emf measurements along three pseudo-binary systems with constant atomic ratios of Sn and Pb of 1/3, 1, and 3, respectively, the partial molar thermodynamic quantities of Zn in the ternary system Zn-Sn-Pb were determined. Equations yielding the integral and partial molar quantities for the three components are reported, and with those the behavior of the boundary of the miscibility gap at the temperatures of 450, 500, 600, and 700 C is described. (*In Italian.*) Ricerche termodimamiche su sistemi metallici. XII. Determinazione della lacuna di miscibilità per calcolo mediante le grandezze termodinamiche per il sistema ternario *Zn-Sn-Pb.* ***Mario Fiorani and Luigi Oleari.*** *Ricerca Scientifica,* v. 29, Nov. 1959, p. 2349-2358.

6494* Correlations Between Electrical Resistivity and Interactions Between Liquid Metal Systems. Zn-Cd-Sb Ternary System. The study of electrical resistivity as a method of investigation into the short-interval order existing in liquid metal solutions was extended to the ternary Zn-Cd-Sb system. A strict correlation was found between resistivity and thermodynamic data, thereby confirming the validity of the resistivity measurement method in the investigation into the interactions existing between the various components in a liquid metal solution of even more components. (*In Italian.*) Correlazione fra resistivà elettrica ed interazioni fra i componenti i systemi metallici liquidi. Sistema ternario *Zn-Cd-Sb.* ***Luigi Oleari and Mario Fiorani.*** *Ricerca Scientifica,* v. 29, Dec. 1959, p. 2589-2597.

6495 Solvent Effects on the Infra-Red Spectra of Hindered Phenols. When a solvent/solute complex is broken by thermal agitation, it seems that reassociation of the phenolic OH with another solvent molecule occurs very rapidly. The introduction of bulky substituents in the immediate neighborhood of the OH group lengthens the time between collisions suitably oriented for association. It then becomes possible to detect free OH absorptions corresponding to solute molecules in transit from one molecular association to another. ***L. J. Bellamy and R. L. Williams.*** *Royal Society, Proceedings,* v. 254, ser. A, Jan. 19, 1960, p. 119-128.

6496* Anodic Oxygen Evolution From an Alkaline Electrolytic Solution. The kinetics of the electrolytic oxygen evolution reaction on Ni anodes in aqueous solutions of different compositions were studied at 20 C in the current density range $2 \cdot 10^{-5}$ to $5 \cdot 10^{-2}$ A cm^{-2}. In pure 1 M KOH solution, the parameter b has the value 0.039. Small amounts of various foreign substances, e. g. $Cr(OH)_3$, when added to such solutions, do not alter the b value; the over-voltage, however, increases with increasing concentration. Another group of substances, among them CuO, causes also an increase in the Tafel slopes. (*In Norwegian.*) Anodisk oksygenutvikling fra alkalisk elektrolyttoppløsning. ***Knut Andreassen.*** *Tidsskrift for Kjemi, Bergvesen og Metallurgi,* v. 19, no. 10, 1959, p. 229 + 3 pages.

6497 Zirconium Fluoride Phase Studies. II. Sodium Fluozirconate Phase Relationships. Ternary diagram developed which provides a systematic approach to the preparation and interconversion of some sodium fluozirconates in low acid, low fluoride, zirconyl systems. ***A. J. Moffat.*** *U. S. Atomic Energy Commission, IDO*-14499, Dec. 31, 1959, 20 pp. (UF767 Un3.1id Contin.)

6498 The Determination of the Melting Point, the Vapor Pressure, and the Decomposition Temperature of Yttrium Tri-Iodide. Yttrium iodide was prepared by reacting yttrium metal turnings with ammonium iodide. The resulting salt was distilled into a melting point assembly and the melting point and vapor pressure were determined by conventional techniques. Little decomposition of the iodide on a hot surface was observed under conditions that gave 100% decomposition of Zr iodide. ***D. H. Dennison, F. H. Spedding, and A. H. Daane.*** *U. S. Atomic Energy Commisison, IS*-57, Nov. 1959, 16 pp. (UF767 Un3.1isu Contin.)

6499 Electronegativities of the Rare-Earth Elements. Electronegativities of the rare-earth elements were caluculated from heats of formation. Revised electronegativity values are given for the more electropositive elements, including the rare-earth metals. ***R. L. Montgomery.*** *U. S. Bureau of Mines Report of Investigations* 5567, 1960, 11 pp. (TN21 Un3r Vis.)

6500* A New Method to Study Chemoluminescence and Fluorescence at the Same Time. The method described permits separate determination of chemoluminescence of reactions, and of fluorescence of appearing substances. Pulsed irradiation with UV light is applied to the specimens. The chemoluminescence of the emission spectrum is oscillographically recorded as continuous constituents, whereas the fluorescence is recorded separately as superimposed alternating current components. (*In German.*) Eine neue Methode zum Studium der Chemilumineszenz bei gleichzeitiger Fluoroeszenz. ***D. S. Bersis.*** *Zeitschrift für Physikalische Chemie* (Frankfurt), v. 22, nos. 5-6, Dec. 1959, p. 328-335.

6501* Determining the Thermodynamics of Polystyrene Solutions by Means of Calorimetric Measurements. The heats of dilution of polystyrene of different molecular weight in benzene, toluene, ethylbenzene and cyclohexane were measured calorimetrically. The results were used together with osmotic measurements, in order to determine the chemical potential of the solvent in the $\Delta\mu$ solution, the dilution enthalpy ΔH, and the dilution entropy ΔS, as function of concentration and molecular weight. (*In German.*) Kalorimetrische Messungen zur Thermodynamik von Polystyrollösungen. ***G. V. Schulz and A. Horbach.*** *Zeitschrift für Physikalische Chemie* (Frankfurt), v. 22, nos. 5-6, Dec. 1959, p. 377-397.

See also: **6840** (electrical calorimeter).

COATINGS

6502* Plastic Pressure-Sensitive Tapes as Pipe Coating Materials. *American Gas Journal,* v. 187, Mar. 1960, p. 26 + 8 pages.

6503* Reactions of Unsaturated Fatty Alcohols. VIII. Preparation and Properties of Some Copolymers of Nonconjugated Linseed Vinyl Ether and Lower Alkyl Vinyl Ethers. A nonconjugated linseed polymer and certain of its copolymers produced satisfactory films when dried in air at room temperature. Nonconjugated linseed homopolymer dried

tack-free in less than 1 hr. and was considered dry in 3 to 4 hr. The films were unusually resistant to acids, alkali, and most organic solvents. ***L. E. Gast, Wilma J. Schneider, J. L. O'Donnell, and H. M. Teeter.*** *American Oil Chemists' Society, Journal*, v. 37, Feb. 1960, p. 78-80.

6504* Epoxy Resins From Fats. III. Preparation and Properties of Resins From Blends of a Commercial Diglycidyl Ether and Epoxidized Glycerides Cured With Phthalic Anhydride. Three series of resins were made by curing mixtures of a diglycidyl ether and epoxidized, natural glycerides with phthalic anhydride. All members of the epoxidized lard oil series took three hours to gel. The heat distortion temperature was a linear function of the percentage of epoxidized oil in each series. ***Leonard L. Belb, et al.*** *American Oil Chemists' Society, Journal*, v. 37, Feb. 1960, p. 81-84.

6505 Application of Isophthalic Acid in Polyester Resins. Isophthalic acid allows production of polyester resins with certain proven adavntages. It is believed that the isophthalic acid will be so improved as to yield lighter colored polyesters. ***Norman Zarick.*** *American Paint Journal*, v. 44, Mar. 7, 1960, p. 34 + 2 pages.

6506 Wood Finishes. Observations on European Practices. Chronology of polyester wood finishes in Germany, polyester finishes in the German wood-finishing market, trends appearing in the European furniture-finishing industry, polyester finishes in the American wood-finishing market, application methods for polyester finishes, spray coating, electrostatic application, adhesion, repair techniques, and other problems. ***Rufus F. Wint.*** *American Paint Journal*, v. 44, Mar. 7, 1960, p. 98 + 9 pages.

6507 Improved NBS Abrasive Jet Method for Measuring Abrasion Resistance of Coatings. ***A. G. Roberts.*** *ASTM Bulletin*, no. 244, Feb. 1960, p. 48-51.

6508 Engineering Approach to a Chemical Plant Coating Program. III. Some Coatings Systems and What Was Learned About Them. IV. Investigating Sandblasting and Coating Application Hazards. *Corrosion*, v. 16, Feb. 1960, p. 20 + 2 pages.

6509 Wrapping for Protection With Petrolatum-Based Tape. ***W. A. Brewis.*** *Corrosion Technology*, v. 7, Jan. 1960, p. 9-11.

6510* Behaviour of Paint Media in Electrostatic Spraying. In electrostatic spraying, drop size and velocity affect the quality of the paint coating while the spray angles provide an indication of the ability of the paint to reach all surfaces of the work presented to the spray. Therefore, when the composition is known, measurements of the conductivity or dielectric constant of the paint can provide some indication of its probable behavior in electrostatic spraying. ***R. Groszteinbeck, H. Holte, and W. Tullius.*** *Electroplating and Metal Finishing*, v. 13, Feb. 1960, p. 63.

6511* Fungicides in Surface-Coatings. After a comparison of various antifungal agents, the organic compounds of Hg, Sn, and Cu are dealt with in detail. Their preparation methods and their chemical and toxicological properties are treated. Application and methods of incorporating them in coating agents are explained. (*In German.*) Fungizide Anstrichmaterialien. ***H. Hirschfeld.*** *Fette, Seifen, Anstrichmittel*, v. 61, no. 12, Dec. 1959, p. 1233 + 6 pages.

6512* Flexographic Printing Tests. I. *Flexography*, v. 5, no. 2, Feb. 1960, p. 18-20.

6513* Organic Coatings for Steel Drums. Problems and Progress in Packaging. External coatings can be applied either by spray or roller. Alkyds, modified with amine resins or epoxy combinations, are used for this purpose. Concerning lacquer lining, there are three types: the oleoresinous, phenol-formaldehyde resins, and the epoxy resins. *Industrial Finishing (London)*, v. 12, Feb. 1960, p. 29 + 2 pages.

6514* Galvanising Steel Wire. Pretreatment Necessary. The main form of pretreatment for steel wires for galvanizing is chemical pickling and the careful removal of all traces of pickling salts by intense washing. *Industrial Finishing (London)*, v. 12, Feb. 1960, p. 43.

6515 Recent Advances in Fused Plastic Coatings for Metals. Polythene coated steel retains the rigidity of steel while having the desirable features of a polythene article. Plastic-coated sheet or strip metal is now available commercially, but its use is limited by the fact that the coating is damaged during fabrication, and a method of coating the fabricated article is to be preferred. ***D. E. J. Cunningham.*** *Institute of Metal Finishing, Transactions*, v. 36, pt. 6, Winter, 1959, p. 189-197.

6516* Corrosion Prevention in Automobile Bodies. The organic finishing of the main part of car bodywork, utilizing heavy undercoats and durable top-coats on steel often prepared by phosphating, has reached a very satisfactory degree of excellence on flat or nearly flat surfaces. Difficulties still arise at edges, corners, crevices, and re-entrants. Relative advantages and disadvantages of trim made from bright anodized Al and from stainless steel are discussed. Newer finishes, such as electrodeposited Ni-Sn alloy coatings, are also considered. Temporary corrosion prevention is described. ***T. P. Hoar.*** *Institution of Mechanical Engineers, Automobile Division, Proceedings*, 1957-1958, no. 2, p. 53-74.

6517 Microstructure of Polymer Coatings on Magnet Wire. ***Gerald W. Recktenwald and Daniel M. Trollinger.*** *Modern Plastics*, v. 37, no. 6, Feb. 1960, p. 134 + 2 pages.

6518* Symposium on Polyurethane Coatings. Eight papers covering studies on one-package polyurethane surface coatings; urethane coatings; diisocyanate adduct coatings; and polyether polyols in urethane coatings. ***M. E. Bailey.*** *Official Digest*, v. 32, Feb. 1960, p. 197-290.

6519* Recent Developments in Polyurethanes. The isocyanate vapor concentrations formed during the brush and spray applications of finishes containing various polyisocyanates and catalyst are compared. The development of a two-feed spray system suitable for the application of urethane lacquers and foams is described. ***H. A. Hampton, R. Hurd, and H. J. Shearing.*** *Oil & Colour Chemists' Association, Journal*, v. 43, Feb. 1960, p. 96-123.

6520* Anti-Corrosive Water-Emulsion Paint for Metal Surfaces, Especially New Galvanised Steel. The well-known difficulties encountered in the preparation and decoration of new galvanized steel surfaces may be overcome by the use of a special oil-free polyacrylic dispersion paint formulated with a correct pigment-binder ratio to assure durability and containing zinc chromate to inhibit corrosion. The paint exhibits remarkable durability, versatility, cheapness, and ease of application. ***D. Frank.*** *Oil & Colour Chemists' Association, Journal*, v. 43, Feb. 1960, p. 140-148.

6521 Anticorrosive and Marine Paints. Urethane coatings, thick coatings, primers and pigments for them, paints for Al, marine anticorrosive paints, antifouling paints are discussed. ***J. C. Kingcome.*** *Paint Manufacture*, v. 30, Feb. 1960, p. 59-62.

6522 Theoretical Aspects of Emulsions. Energy relations at interfaces, adsorption and surface activity, interfacial films in emulsions, properties of interfacial monolayers, emulsifying agents, amine soaps, sulfated oils, and other problems are discussed. ***C. G. Sumner.*** *Paint Technology*, v. 24, Jan. 1960, p. 14 + 9 pages.

6523* New Horizons for Corrugated Super-Strength Impregnated Board. ***Murray Wolf.*** *Paperboard Packaging*, v. 45, Feb. 1960, p. 55-61.

6524 Ageing Effects in Bimetallic Films. Measurements of adhesion have been made on films of Ag, Au, Cu, and Al with underlayers of Cr. It has been shown that in the case of bimetallic films, abnormally high figures may be obtained due to the formation of an intermediate layer by diffusion or intermetallic reaction. The results show a dependence upon the thickness of the Cr underlayer and time as well as upon the metal of the upper layer. ***C. Weaver and R. M. Hill.*** *Philosophical Magazine*, v. 4, ser. 8, Oct. 1959, p. 1107-1125.

6525* Corrosion Protection With an Asbestos Emulsion. Flame cleaning is preferred for rust removal, followed by wire brushing. Normally, a red lead primer is applied. Two coats of emulsion are then brushed on, followed by two coats of Al paint. *Product Finishing*, v. 13, Feb. 1960, p. 88-90.

6526* Organic Finishes for Metal. VIII. Advantages and disadvantages of the lacquer-curtain coating machine are discussed. ***B. M. Letsky.*** *Product Finishing*, v. 13, Feb. 1960, p. 98-100.

6527 Paints in the Tropics. I. Describes the conditions of exposure in the tropics. ***P. Whiteley.*** *World Crops*, v. 12, Feb. 1960, p. 72-73.

See also: **6361** (antioxidants and asphalt durability); **7380** (hot melt adhesives).

CONTROL SYSTEMS, COMPUTERS, AND SYSTEMS ENGINEERING

6528* Analysis of Nonlinear Sampled-Data. I. II. Control Systems. The methods developed are relatively easily and quickly applied, requiring only algebraic operations and a z-transform table. Methods for obtaining the numerical solution of nonlinear sampled-data control systems are described. The use of these methods makes it possible to obtain solutions to important nonlinear control system problems which cannot be solved by conventional methods. ***K. Kinnen and J. Tou.*** *Applications and Industry*, 1960, no. 46, Jan., p. 386-394.

6529* Computer Evaluation of High-Temperature Aircraft A-C Electrical System Designs. The study includes an extensive, nonlinear representation of the a-c alternator and shows the effects of temperature, load, and regulator and exciter nonlinear behavior on system stability and transient performance. ***W. E. Sollecito and D. A. Swann.*** *Applications and Industry*, 1960, no. 46, Jan., p. 434-444.

6530* Application of Switching Transistors and Saturable Reactors in a High-Performance Servo. Substitution of solid-state devices for electronic amplifiers and mechanical choppers not only increases the efficiency, the reliability, and the durability of the system but also minimizes its size and weight. ***Fred B. Cox and Paul R. Johannessen.*** *Applications and Industry*, 1960, no. 46, Jan., p. 466-474.

6531* Analysis of A-C Servomotors Operated From Unbalanced Nonsinusoidal Voltage Sources and Nonlinear Discontinuous Source Impedances. The analysis of 2-phase servomotors excited through stator impedances which are nonlinear discontinuous functions of time and current can be accomplished through the use of the analog computer. ***E. R. Lind and N. L. Schmitz.*** *Applications and Industry*, 1960, no. 46, Jan., p. 476-481.

6532* A Suppressed-Carrier Signal Generator for Servosystem Instrumentation. Describes a method of obtaining a sinusoidal suppressed carrier voltage using two synchros connected in such a way as to eliminate the need for slip rings. ***P. J. Pollard.*** *Applications and Industry*, 1960, no. 46, Jan., p. 481-485.

6533* Control by Stochastic Adjustment. Considers the problem of designing an "adaptive controller" for the control of a certain class of dynamic processes. In general, these processes consist of a dynamic element governed by a nonstationary, linear differential equation. ***J. E. Bertram.*** *Applications and Industry*, 1960, no. 46, Jan., p. 485-491.

6534* Transient Response and the Stabilization of Feedback Amplifiers. By the combination of root-locus methods and the concept of the dominance of the step-function response, it is possible to formulate a stabilization design criterion for feedback amplifiers based on direct control of the transient response. The damping or rate of attenuation of the dominant time term in the step-function response, is a simple function of the pole angle of the dominant pair of complex poles. ***J. H. Mulligan, Jr.*** *Applications and Industry*, 1960, no. 46, Jan. p. 495-503.

6535* Proposed Recommended Practices for Medium-Voltage Motor Controllers for Rubber and Plastics Industries. Enclosure; power busses; isolating device; interrupting rating; contactors; accessibility; interlock requirements; protective devices; wiring diagrams are discussed. ***William S. Watkins.*** *Applications and Industry*, 1960, no. 46, Jan., p. 504-506.

6536* Use of a Mathematical Error Criterion in the Design of Adaptive Control Systems. Mathematical error criteria are examined in terms of the goals of an adaptive control system. For dynamic processes which contain pure-time delay, a modification of these error criteria is postulated. ***C. W. Merriam, III.*** *Applications and Industry*, 1960, no. 46, Jan., p. 506-512.

6537* A Method for the Symbolic Representation and Analysis of Linear Periodic Feedback Systems. The symbolic representations are easily obtained and lead directly to a concise mathematical formulation in terms of a state vector representing both the input and system variables. System response at multiples of the fundamental period, obtained by Z-transform methods, is presented in a concise vector matrix notation. ***Edward O. Gilbert.*** *Applications and Industry*, 1960, no. 46, Jan., p. 512-523.

6538* Executive-Controlled Adaptive Systems. By dividing the responsibilities of the computer into three distinct functions: process measurement, performance maintenance, and signal generation, the problems associated with process adaptability and signal adaptability can be treated separately, with the final designs fused together. ***Robert Staffin.*** *Applications and Industry*, 1960, no. 46, Jan., p. 523-530.

6539* Sequential Formula Translation. This description of syntax furnishes at the same time an extremely simple rule for translating into machine programs statements in the algorithmic language. Sequential treatment, however, is not feasible in the case of certain optimizing processes such as recursive address calculation. ***K. Samelson and F. L. Bauer.*** *Association for Computing Machinery, Communications*, v. 3, Feb. 1960, p. 76-83.

6540* Mathematical Investigations Related to the Use of Electronic Computing Machines. Theoretical investigations on programing, nonarithmetic uses of computing machines, theoretical investigations of control systems, certain other problems of mathematical cybenetics are discussed. ***A. A. Liapunov.*** *Association for Computing Machinery, Communications*, v. 3, Feb. 1960, p. 107-118.

6541* Input-Output Buffering and Fortran. This paper is primarily concerned with magnetic tape input and output. Variable and fixed buffering, evaluation, the buffering method for Fortran object routines, buffered subroutines for Fortran object routines are discussed. ***David E. Ferguson.*** *Association for Computing Machinery, Journal*, v. 7, no. 1, Jan. 1960, p. 1-9.

6542* Changing From Analog to Digital Programming by Digital Techniques. Introduction, analog computer diagrams, the initial equation associated with any output, diagrams to differential equations, termination of the substitution process, sequential substitution technique, the detection of implicit outputs, computer techniques are discussed. ***Marvin L. Stein and Jack Rose.*** *Association for Computing Machinery, Journal*, v. 7, no. 1, Jan. 1960, p. 10-23.

6543* Sequential Machines, Ambiguity, and Dynamic Programming. Given a sequential machine, a problem of some interest is that of determining testing procedures which will enable one to transform it into a known state starting from an initial situation in which only the set of possible states is given. ***Richard Bellman.*** *Association for Computing Machinery, Journal*, v. 7, no. 1, Jan. 1960, p. 24-28.

6544* A Numerical Method for Solving Control Differential Equations on Digital Computers. Frequently, as in missile control systems, linear differential equations are simultaneous with nonlinear but slower acting differential equations. The numerical solution of this type of system on a digital computer is significantly speeded up by approximating the forcing functions with polynomials, solving the linear equations exactly, and numerically integrating the nonlinear equations with Milne integration. ***W. H. Anderson, R. B. Ball, and J. R. Voss.*** *Association for Computing Machinery, Journal*, v. 7, no. 1, Jan. 1960, p. 61-68.

6545* A New Pseudo-Random Number Generator. The sequence: $x_{i+1} = (2^a + 1)\, x_i + c \pmod{2^{35}}$ has been tested on the IBM 704. It is shown that the sequence generates

the full period of 2^{35} numbers for a $\geqq 2$ and c odd. It takes 14 machine cycles on the IBM 704, compared to 28 for the multiplicative method. ***A. Rotenberg.*** *Association for Computing Machinery, Journal*, v. 7, no. 1, Jan. 1960, p. 75-77.

6546* Role of Computers in Automation. The basis for review, a complex field, scientific applications, control and administrative applications, digital and analog computers are discussed. ***J. H. McRainey.*** *Automation*, v. 7, Mar. 1960, p. 48-57.

6547 Digital and Sampled-Data Control Systems. Continuous-data control systems; basic theory of sampling and quantizing; frequency domain analysis; *z*-transform analysis; transient response and system-error analysis; analog-digital conversion principles; general design principles. ***Julius T. Tou.*** 631 pp. 1959. McGraw-Hill, New York. (TJ213 T64d)

6548 Electronic Computers. Principles and Applications. Evolution of the computor, general principles of compution, analogue computing circuits 1 and 2, equipment of analogue computers, applications of analogue computers, digital computer circuits 1 and 2, storage systems, digital computer equipment and other problems are discussed. ***T. E. Ivall.*** 2nd Ed. 263 pp. 1960. Philosophical Library, New York. (TK7872.C5 Ivle2)

6549 A Magnetic Drum Memory With a One Megabit Storage. Design engineers took an existing magnetic drum memory and increased its capabilities eight times. Their ideas and innovations, given here, will prove useful to other design engineers. ***Robert R. Schaffer.*** *Electronic Industries*, v. 19, Mar. 1960, p. 114-117.

6550 Feedback and NOR Logic Yield Sound Spot Welds. The basis efficiency of spot welding lies in the fact that heat is generated between the two parts, so that the bond between the two metal parts is formed from the inside out, in distinction to riveting or other fastening techniques, where the attachments are made from the outside in. ***G. R. Archer.*** *Electronics*, v. 33, no. 8, Feb. 19, 1960, p. 48-51.

6551 Computer Switching With High-Power Transistors. The problem how to select the right power transistor and switching circuit to obtain required switching speed, gain and current-carrying capacity is discussed in detail. ***James S. Ronne.*** *Electronics*, v. 33, no. 10, Mar. 4, 1960, p. 44-47.

6552 Expandable Random Access Memories. These expandable solid-state memories operate in an ambient temperature of from 15 to 55 C and require no better than plus or minus three per cent supplies. Plug-in feature provides unusual economy. ***George E. Lund and Donald R. Faulis.*** *Electronics*, v. 33, no. 11, Mar. 11, 1960, p. 164-166.

6553* Electronic 'Rotor'—Analogue Computing Element. This article discusses a novel method which was developed for introducing the concepts of bearing and angle into fast cartesian analogue computations, without the use of mechanical shafts and servomechanisms. ***J. S. Johnston.*** *Electronic Technology*, v. 37, Jan. 1960, p. 2-6.

6554 Information Transmission, Modulation, and Noise. Introduction to information transmission, transmission through electric networks, modulation and modulation systems, periodic sampling and pulse modulation, noise comparative analysis of information-transmission systems, statistical methods in analysis of information-transmission systems. ***Mischa Schwartz.*** 461 pp. 1959. McGraw-Hill, New York. (TK5101 Sch95i)

6555 A Class of Systematic Codes for Non-Independent Errors. A class of systematic codes was obtained which will correct all single errors and all double errors which occur in adjacent digits. These codes use significantly fewer checking digits than codes which correct all double errors. In addition, because of inherent regularities in their structure, these codes may be instrumented in a strikingly simple fashion. ***N. M. Abramson.*** *IRE Transactions on Information Theory*, v. IT-5, no. 4, Dec. 1959, p. 150-157. (TK1 In6.6it Vis.)

6556 A Probabilistic Model for Run-Length Coding of Pictures. A first-order Markoff process representation for pictures is proposed in order to study the picture coding system known as run-length coding (differential-coordinate encoding). A lower bound for the saving in channel capacity is calculated on the basis of this model, and is compared with the results obtained by previous investigators. ***Jack Capon.*** *IRE Transactions on Information Theory*, v. IT-5, no. 4, Dec. 1959, p. 157-163. (TK1 In6.6it Vis.)

6557 A Note on Invariant Relations for Ambiguity and Distance Functions. A "distance" function for two time functions is defined to be the integrated squared difference between these functions. The relation for the squared real part of the ambiguity function readily yields an invariant relation for the volume associated with this distance function in the case of Hilbert-derived complex time functions. ***C. A. Stutt.*** *IRE Transactions on Information Theory*, v. IT-5, no. 4, Dec. 1959, p. 164-167. (TK1 In6.6it Vis.)

6558 On Upper Bounds for Error Detecting and Error Correcting Codes of Finite Length. One upper bound is found by exploiting the geometrical model of coding introduced by Hamming. The volume of an appropriate geometrical body is compared with the volume of the unit cube, in getting the first upper bound. ***Nelson Wax.*** *IRE Transactions on Information Theory*, v. IT-5, no. 4, Dec. 1959, p. 168-174. (TK1 In6.6it Vis.)

6559 The Probability Density of the Output of an RC Filter When the Input Is a Binary Random Process. The method for determining the probability density involves a linear integral equation which can be reduced by Laplace transforms. A new family of solutions is given which includes two previously known cases: the random square wave of Poisson type, and the periodic square wave with random time origin. ***J. A. McFadden.*** *IRE Transactions on Information Theory*, v. IT-5, no. 4, Dec. 1959, p. 174-178. (TK1 In6.6it Vis.)

6560 Recurrent Events in a Bernoulli Sequence. The "point of regeneration" method is used to obtain simple sequential equations for determining the complete probability density function for multiple occurrences of events in a Bernoulli sequence. Both the independent and overlapping classes of recurrent events are included in the general framework of these equations. ***M. B. Marcus.*** *IRE Transactions on Information Theory*, v. IT-5, no. 4, Dec. 1959, p. 179-183. (TK1 In6.6it Vis.)

6561 Respiratory Control of Heart Rate: Laws Derived From Analog Computer Simulation. The change in heart rate from beat to beat caused by respiration can be predicted through appropriate differential equations on the analog computer. ***Manfred Clynes.*** *IRE Transactions on Medical Electronics*, v. ME-7, no. 1, Jan. 1960, p. 2-14. (TK1 In6.6m Vis.)

6562 The Use of Electronic Computers in Medical Data Processing: Aids in Diagnosis, Current Information Retrieval, and Medical Record Keeping. Some of the potential advantages of computer aids to medical data processing are: making available to the physician quantitative methods in areas relating to data analysis and differential diagnosis; assisting in the evaluation of the best alternative courses of action during stages of the diagnostic testing processes; making easily available to the physician reference to the most current information about new preventive measures. ***R. S. Ledley and L. B. Lusted.*** *IRE Transactions on Medical Electronics*, v. ME-7, no. 1, Jan. 1960, p. 31-47. (TK1 In6.6m Vis.)

6563* Electro-Hydraulic Control Gear for the "Tully" Carburetted Complete Gasification Process. The cycle for the process consists of six phases: blow phase, purge phase, up run with oil phase, up run phase, back run phase, and purge up run phase. The automatic control components can be divided into five main groups: plant process valves, hydraulic system, cyclic control system, interlock system, and master control. There are four sets of indicator circuits. *Process Control and Automation*, v. 7, Feb. 1960, p. 55-62.

ELECTRICAL ENGINEERING

6564* A Solid Rotor A-C Generator for High-Temperature Electrical Systems. A configuration combining inductor and Lundell machines has been developed to overcome the dis-

advantages that these configurations exhibit separately. The inductor-Lundell combination provides generally lighterweights than either of the separate types. ***J. T. Bateman.*** *Applications and Industry,* 1960, no. 46, Jan., p. 400-403.

6565* Dual-Mode Relay Servos. A design concept was developed for a dual-mode relay servo which employs linear networks in both the saturated mode and the linear mode. This design provides near optimum step response in the saturated mode and near linear response in the quasi-linear mode with no additional complexity beyond a lead lag network. ***R. N. Buland and N. Furumoto.*** *Applications and Industry,* 1960, no. 46, Jan., p. 405-411.

6566* Constant-Frequency A-C Power Using Variable Speed Generation. A method for obtaining constant-frequency alternating-current electric power from a variable speed generator was described. This is accomplished through use of switching circuits which are naturally bilateral, without previous rectification. ***R. D. Jessee and W. J. Spaven.*** *Applications and Industry,* 1960, no. 46, Jan., p. 411-418.

6567* Characteristics and Measurement of Ripple in Aircraft Electric Power Systems. Describes the work accomplished at Nadevcen (the Naval Air Development Center) to develop definition of frequency characteristic of ripple and to provide guidance in the voltage measurement of ripple. Factors influencing the unpredictable variations in ripple measurements are recognized and noted for guidance. ***Oscar Markowitz.*** *Applications and Industry,* 1960, no. 46, Jan., p. 418-423.

6568* Reliability Analysis for Aircraft Generators. Operational reliability and simulated-service reliability are two different things and should be clearly recognized as such. They should be as close together a possible, and the responsibility for the degree of agreement between them must lie with the specification which establishes the methods of measurement. ***J. T. Duane and L. J. Yeager.*** *Applications and Industry,* 1960, no. 46, Jan., p. 426-434.

6569* New Materials for Transformer-Rectifier Unit in High-Temperature Aircraft. Further investigations of the properties of ferromagnetic alloys were carried out. The evaluation of these materials and components indicates a successful transformer-rectifier power supply can be built with the circuit configuration described. ***J. G. Hoop and D. K. McIlvaine.*** *Applications and Industry,* 1960, no. 46, Jan., p. 450-456.

6570 The Electrical and Magnetic Properties of Solids. Electrical conductivity, emission and contact phenomena in metals; properties of semiconductors; superconductivity; dielectrics; ferroelectricity; dia- and para-magnetism; ferro- and antiferro-magnetism. ***N. Cusack.*** 428 pp. 1958. Longmans, Green and Co., New York. (QC125 C95e)

6571 Impedance Bridge for Surface Temperature Measurement. The instrument is based on a sinusoidal eddy current method and provides an output function of the mold surface temperature only; it is free from thermal drifts and permits accurate and reproducible temperature measurements over a wide range. The instrument is basically a 200-cycle a-c comparison bridge followed by a phase-sensing detector. ***R. J. Mouly.*** *Electrical Engineering,* v. 79, Feb. 1960, p. 133.

6572 SSB/ISB Systems for Long-Distance Radiotelegraphy. High-power single side band and independent side band transmitters together with their techniques augur the greatest growth possibilities since the inception of radiotelegraphy. This type of transmission will enable the industry to increase traffic at the same time that frequency occupancy is reduced. ***Walter Lyons.*** *Electrical Engineering,* v. 79, Feb. 1960, p. 146-149.

6573 Controlling Alternator Frequency. This new system holds the frequency within 0.4 cps at 400 cps by nulling a line frequency signal and a precise reference frequency through an electrical differential. ***Harry Etches.*** *Electronic Industries,* v. 19, Mar. 1960, p. 104-109.

6574 Solar-Cell Power Supplies for Satellites. For reliability in the space environment, Si solar cells are proving their worth. In this article, basic design considerations are treated with details of their applications of the Able-4 Atlas space probes. ***Roy M. Acker, Robert P. Lipkis, Raymond S. Miller, and Paul C. Robison.*** *Electronics,* v. 33, no. 11, Mar. 11, 1960, p. 167-172.

6575* Electricity in Steel-Making. The principal types of hot-rolling mill are mentioned. Descriptions are provided of the salient characteristics of the electric drives and of how power is supplied partly by generation and partly by the supply undertaking. ***T. B. Rolls.*** *Institution of Electrical Engineers, Journal,* v. 6, no. 62, Feb. 1960, p. 83-89.

6576* Selection of Relaying Quantities for Differential Feeder Protection. The analysis is presented in the form of curves giving the relaying quantity in terms of the important components of the various phase-sequence impedances of the power system. From these curves, it is possible to compare the different ways of deriving the single-phase relaying quantity and thence to specify the general rules for selection of phase-sequence networks. ***Colin Adamson and E. A. Talkhan.*** *Institution of Electrical Engineers, Proceedings,* v. 107, pt. A, no. 31, Feb. 1960, p. 37-47.

6577* An Experimental Impedance Relay Using the Hall Effect in a Semiconductor. The paper describes a new type of "definite" impedance relay applicable to the protection of power transmission systems. Its operation is based upon a differential balance, under normal conditions, between the output from Hall effect in a semiconductor element and a rectifier unit. The experimental results obtained demonstrate the success of this instrument in principle. ***H. E. M. Barlow and J. C. Beal.*** *Institution of Electrical Engineers, Proceedings,* v. 107, pt. A, no. 31, Feb. 1960, p. 48-50.

6578* The Measurement of Transient Torque and Load Angle in Model Synchronous Machines. The torque meter uses resistance strain gages mounted on a special coupling connected mechanically to the machine shaft. The load-angle meter operates by generating a succession of pulses which modulate the intensity of an oscillograph beam as it traverses a periodic wave. ***R. N. Sudan, V. N. Manohar, and B. Adkins.*** *Institution of Electrical Engineers, Proceedings,* v. 107, pt. A, no. 31, Feb. 1960, p. 51-60.

6579* Transient Torque and Load Angle of a Synchronous Generator Following Several Types of System Disturbance. The following conditions are considered: after a sudden short-circuit; after switching in a reactance between the generator and the supply; asynchronous operation; resynchronization after asynchronous operation. ***D. B. Mehta and B. Adkins.*** *Institution of Electrical Engineers, Proceedings,* v. 107, pt. A, no. 31, Feb. 1960, p. 61-74.

6580 The Admittance and Transfer Functions of Solid Core Electromagnets. External eddy currents produce a zero and a second pole in the magnet admittance and attenuate the effect of rapid variations of magnet current on the magnetic field. The effect of external eddy currents may be obscured by internal eddy currents, and vice versa depending on the relative time constants. Internal eddy currents tend to produce an attenuation rate of 10 db per decade for the magnet admittance and transfer function. Their effect may be obscured by either external eddy currents or by large leakage inductance. ***N. F. Ziegler.*** *U. S. Atomic Energy Commission, ORNL-2860,* Jan. 18, 1960, 53 pp. (UF767 U3o Contin.)

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6581* Electrochemical Characteristics of FeO-MnO-SiO_2 Melts. The properties of the FeO-MnO-SiO_2 system were studied by current efficiency measurements of melts contained in an Fe crucible. Iron electrodes were used and current efficiency was determined from the amount of anodic dissolution. In all melts, the efficiency was less than 100% and this deviation is attributed to the presence of positive hole conduction. Both the positive hole and ionic conductivities decrease in magnitude with increasing MnO and SiO_2 concentration. ***D. A. Dukelow and G. Derge.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 136-141.

6582 Electrochemical Engineering. Problems of theoretical electrochemistry, electrolytics, fused salts, electrothermics, electrochemistry of gases, chemelectrics, and engineering are discussed. ***C. L. Mantell.*** 4th Ed. 680 pp. 1960. McGraw-Hill, New York. (TP255 M31i4)

6583 The Relationship Between Brightness and Structure in Electroplated Nickel. Nickel deposits of various brightnesses were plated from Watts baths containing several different addition agents. The as-plated surfaces of the deposits were examined by electron microscopy. All bright deposits had a very fine-grained structure. However, some fine-grained deposits showed surface crevices and were therefore not bright. A linear relationship between the fraction of the surface area having a roughness less than 0.15 μ and the logarithm of light reflected as measured with a photocell was found. ***R. Weil and R. Paquin.*** *Electrochemical Society, Journal,* v. 107, Feb. 1960, p. 87-91.

6584 The Adhesion of Electrodeposited Nickel to Chromium at Elevated Temperatures. The use of a composite coating of electrodeposited Ni and Cr to protect Mo from oxidation at elevated temperatures has certain practical limitations. Examination of the composite coating showed that the problems of blister formation, weakening of the bond between Ni and Cr, and edge separation were interrelated. Blister formation was eliminated and edge separation reduced slightly by an improved treatment of the Cr surface prior to Ni plating. The weakening of the bond between Ni and Cr appears to be inherent in the coating system. ***Walter E. Reid, Jr. and Fielding Ogburn.*** *Electrochemical Society, Journal,* v. 107, Feb. 1960, p. 91-93.

6585 A Phase Equilibrium Study of the System Na_2WO_4-Na_2CO_3-H_2O. A phase equilibrium diagram representing the binary system Na_2WO_4-H_2O between −7.5 and +35 C was constructed. This curve shows the regions of stability of the dihydrate and decahydrate of Na_2WO_4. Projections showing temperature contours and crystallization paths were given. The regions of initial crystallization of the various salts were presented. Applications of the diagram to fractional crystallizations were discussed. ***R. L. Pilloton and G. E. Crawley, Jr.*** *Electrochemical Society, Journal,* v. 107, Feb. 1960, p. 122-126.

6586 Some Techniques in Studying Rates of Deposition and Formation of Inorganic Films on Metal Surfaces. During the last few years, interest in electrochemical kinetics was considerably stimulated by the application of various relaxation techniques and a general account of these advances in method is presented, bearing in mind most particularly the problem of metal deposition. Inorganic rather than metal films are referred to, since recent work at Newcastle on the kinetics of anodic electrocrystallization is briefly described: there is good reason to believe that analogous methods would be directly applicable and valuable when employed in the study of cathodic processes. ***H. R. Thirsk and W. F. K. Wynne-Jones.*** *Institute of Metal Finishing, Transactions,* v. 36, pt. 6, Winter, 1959, p. 198-202.

6587 Sealing Anodic Oxide Films on Aluminium. The literature is critically reviewed to give an up-to-date survey of the subject. It is evident that, although the nature of the unsealed film is fairly well understood, relatively little is known of the mechanism of sealing. ***G. C. Wood.*** *Institute of Metal Finishing, Transactions,* v. 36, pt. 6, Winter, 1959, p. 220-229.

6588 Hardness and Structural Transformations in Electrodeposited Copper-Zinc Alloys. Brasses ranging from 88 to 15% Cu, prepared by electrodeposition, were examined immediately after plating by microhardness testing and the X-ray back-reflection method. A soft ductile deposit transformed in ten days to the hard γ phase. ***John Cole and Hugh O'Neill.*** *Institute of Metals, Journal,* v. 88, pt. 4, Dec. 1959, p. 159-164.

6589 New Anodic Process Hard-Coats Aluminum Parts at High Speed. Heart of a new anodizing method is its ability to use very high current densities. Coatings, equal in quality to those produced by other methods, are light in color. *Iron Age,* v. 185, no. 7, Feb. 18, 1960, p. 118-119.

6590 Use of Disodium M-Benzenedisulfonate as a Hardening Agent in a Watts Nickel Bath. Disodium M-benzenedisulfonate increases deposit hardness to a maximum of 350 VHN at a concentration of 0.3 g/l and above, at 5 amp./dm^2, 50 C and pH 5.0. The stress varies from 20,000 psi tensile to 5,000 psi compressive over a range of concentration of the additive from zero to 0.4 g/l. ***William H. Metzger, Jr., Paul A. Krasley, and Fielding Ogburn.*** *Plating,* v. 47, Mar. 1960, p. 285-287.

ELECTRONICS

6591* Nuclear Radiation and Electronic Equipment. Suggestions for designing radiation-tolerant electronic amplifiers are given as follows: Keep resistance values low. Use materials compatible with the environment. Avoid large capacitor values. Keep the circuit simple. ***J. R. Crittenden.*** *Applications and Industry,* 1960, no. 46, Jan., p. 423-426.

6592* Microwave Television Mobile Relay for Outside Broadcasting. A brief account is given of the principal qualities required in mobile links. These include transmission of picture and sound without degradation of the quality and stability in time of the technical performances. The essential causes of distortion introduced in the transmission by a microwave link are reviewed. ***J. Polonsky.*** *British Institution of Radio Engineers, Journal,* v. 20, Feb. 1960, p. 91-102.

6593* A Transductor Regulator for Stabilized Power Supplies. A new form of transductor regulator is described which is principally intended for use in voltage-stabilized power supplies delivering output currents of ~1 A. Better efficiency and reliability is obtained than is usually possible with the conventional series-valve regulator, and the complete power supply can also be physically smaller. ***A. N. Heightman.*** *British Institution of Radio Engineers, Journal,* v. 20, Feb. 1960, p. 105-123.

6594* Reduction of Television Bandwidth by Frequency-Interlace. A method analogous to the N.T.S.C. color television is used to obtain a bandwidth reduction of a black-and-white video signal by a factor of approximately 2:1. The normal signal is split into two frequency bands, nominally zero to 1.5 Mc/s and 1.5 to 3.0 Mc/s. The latter is used to amplitude-modulate a subcarrier. ***E. A. Howson and D. A. Bell.*** *British Institution of Radio Engineers, Journal,* v. 20, Feb. 1960, p. 127-136.

6595* Reflection Coefficient Curves of Compensated Discontinuities on Coaxial Lines and the Determinaiton of the Optimum Dimensions. Discontinuities on coaxial lines are caused either by irregular cross-section or variation of dielectric constant. Equivalent circuits of different types of discontinuity are given. The node-shift technique employing an adjustable short circuit for determining the reflection coefficient is described. ***A. Kraus.*** *British Institution of Radio Engineers, Journal,* v. 20, Feb. 1960, p. 137-152.

6596 The Possibility of Obtaining Polymeric Materials, Based on Polyacrylonitrile, With Semiconducting Properties. Materials obtained, based on polyacrylonitrile, have typical semiconducting properties, and by virtue of their nature and great resistance of heat, can work at raised temperatures. Since polyacrylonitrile swells in concentrated solutions of salts, it is possible to introduce into a polymer, before thermal treatment, ions of metals which could be donors of electrons. The reaction of γ-radiation on a polymer makes more effective the subsequent heat treatment for obtaining materials with semiconducting properties. ***A. V. Topchiyev, et al.*** *Chemistry & Industry,* 1960, no. 8, Feb. 20, p. 184-186.

6597 Life Characteristics of Carbon-Film Resistors. The carbon-film resistor types investigated were ½-watt 237,000-ohm (critical value) resistors and ½-watt 100,000-ohm borocarbon resistors, with a nominal tolerance of ± 1%. Four brands for resistors were included, of which three were deposited-carbon-film type and the fourth a borocarbon-film type. It was found that the carbon-film resistors of manufacturers *A*, *B*, and *C* have average failure rates ranging from about 0.13 to 2.3% per 1,000 hours. In addition, some types of carbon-film resistors exhibited a number of catastrophic failures and case defects, similar to crazing, on the outer surface. The borocarbon-film

resistors of manufacturer *D* experienced an average failure rate (using the 2% criterion) of about 10% per 1,000 hours. ***H. M. Braner and J. L. Easterday.*** *Electrical Engineering*, v. 79, Feb. 1960, p. 124.

6598 Precision Integrator for D-C Potentials. An integrator is described for time-integrating direct potentials of either polarity up to 70 millivolts average value with a resolving power of five microvolts. Currents can be integrated by means of shunts, and power by means of watt converters. ***J. R. Pattee.*** *Electrical Engineering*, v. 79, Feb. 1960, p. 125.

6599 Pictorial Data Transmission From a Space Vehicle. Space communications pose a unique set of problems in line-of-sight transmission. Major ones include nonstationary terminals, the astronomical distances involved, and bandwidth restrictions consistent with power restrictions. There are also conflicting requirements of maximum reliability and minimum weight of equipment. ***J. F. Baumunk and S. H. Roth.*** *Electrical Engineering*, v. 79, Feb. 1960, p. 134-138.

6600 Influence of Crystal Size on the Spectral Response Limit of Evaporated PbTe and PbSe Photoconductive Cells. Photoconductive layers of PbTe were formed by evaporation on substrates at different temperatures. The size of crystals in the layers was estimated from electron micrographs and X-ray diffraction, and a correspondence was obtained between crystal size and the limit of spectral response. Sensitivity up to the long wave-length limit set by the energy gap is not achieved unless the crystals are greater than a critical size; for lead telluride this is about a quarter of a micron. A similar effect was shown to occur with PbSe. ***W. D. Lawson, F. A. Smith, and A. S. Young.*** *Electrochemical Society, Journal*, v. 107, Mar. 1960, p. 206-210.

6601 Molecular Electronics. Investigation with the 3-5 compounds supports our approach to the development of heat- and radiation-resistant materials. Our ability to produce large, perfectly flat working surfaces on crystals of Ge will be basic to increasing the power-handling capacity of molecular electronic function blocks. *Electronic Industries*, v. 19, Mar. 1960, p. 100 + 5 pages.

6602 Using the Tunnel Diode. Recognizing the tunnel diode's potential, the semiconductor industry has swung into serious application development. This article presents some general considerations on their use as amplifiers. ***Erich Gottlieb.*** *Electronic Industries*, v. 19, Mar. 1960, p. 110-113.

6603 Accurate Tracking for Radiotheodolites. High accuracy is attained by a push-pull arrangement of hysteresis clutches which smoothly transfers torque through dual gear trains from the drive motor to the antenna. ***Fred Ellis.*** *Electronic Industries*, v. 19, Mar. 1960, p. 118-120.

6604 The AC Potentiometer—a New Circuit Component. Autotransformers have a number of very desirable characteristics. These characteristics are also desirable in a precision potentiometer. The union of the two produces an extremely useful new component. ***Lionel Robbins.*** *Electronic Industries*, v. 19, Mar. 1960, p. 120-124.

6605 Making Transmitters RFI-Free. If all the signal sources inside the transmitter are known, then the frequencies at which the interference will appear can be calculated by rather simple linear equations. It is somewhat more difficult to calculate amplitudes, because these depend on nonlinearities. ***C. E. Blakely and R. N. Bailey.*** *Electronic Industries*, v. 19, Mar. 1960, p. 132-141.

6606 New Suppressed-Carrier Modulation Technique. Provides saving of power required for carrier generation and permits exalted-carrier detection for communications circuit noise advantage. ***John Dysinger, William Whyland, and Robert Wood.*** *Electronics*, v. 33, no. 6, Feb. 5, 1960, p. 47-49.

6607 Electronics Research & Development Around the World. Considers Si parametric diode, microelectron-probe for analysis of alloys, some component miniaturization, free magnetic rings in plasma, important research in maser, new ferrites for loudspeakers, semiconductors, radio astronomy and others. ***W. W. MacDonald, editor.*** *Electronics*, v. 33, no. 7, Feb. 12, 1960, p. 75-98.

6608 Three-Element Semiconductor Materials. Compounds containing elements from Groups 4b, 5b, and 6b may have a large covalent component to the bonding, an apparent necessary feature for intrinsic semiconductivity, and such compounds should therefore be semiconductors. The compound $AgSbTe_2$ has been added to the list of new semiconductors, but much remains to be learned. ***J. H. Wernick and R. Wolfe.*** *Electronics*, v. 33, no. 7, Feb. 12, 1960, p. 103-108.

6609 Determining Sonar System Capability. Range parameters of modern active and passive sonar systems under various operational and sea conditions can be calculated with the aid of equations and charts given in this article. ***George Rand.*** *Electronics*, v. 33, no. 8, Feb. 19, 1960, p. 41-45.

6610 Solid-State Dielectric Circuit Devices. Controlled current flow in insulators points to new class of devices. Cadmium sulphide diodes were built and triodes are envisioned. ***G. T. Wright.*** *Electronics*, v. 33, no. 9, Feb. 26, 1960, p. 59-61.

6611 Designing Transducers for Sonar Systems. Key element in determining performance of modern sonar systems is the transducer. Data for selection of materials and backing-plate design for a desired beam pattern are given. ***George Rand.*** *Electronics*, v. 33, no. 9, Feb. 26, 1960, p. 62-65.

6612 Power Amplifiers Using Electro-Optical Effects. Here is a listing of the 27 power amplifiers that can be designed to use various combinations of electric, radiative and thermal power. ***G. Diemer.*** *Electronics*, v. 33, no. 9, Feb. 26, 1960, p. 71-73.

6613 Recent Progress in Solid State Technology. Growing complexity of systems is intensifying demands for size reduction, better reliability and lower cost. Concentrated development work on solid-state devices and circuits is bringing system microminiaturization closer. ***M. M. Perugini and Nilo Lindgren.*** *Electronics*, v. 33, no. 10, Mar. 4, 1960, p. 39-43.

6614 X-Band Horn Antenna Has Broad Beamwidth. Elliptically-polarized antenna has 3-db and 6-db beamwidths of 140 degrees. Applications are in countermeasure, telemeter and beacon systems. ***Raymond E. Metter.*** *Electronics*, v. 33, no. 10, Mar. 4, 1960, p. 50-53.

6615* Rectangular-Waveguide Loads. Resistive Element Strips. Certain modifications are described to the construction and mounting of resistive element dissipative strips when used either as a fixed flat load or as an adjustable sliding termination. Results are given of measurements made in S-band but the technique is adaptable to all sizes of rectangular waveguide. ***W. Geoffrey Voss.*** *Electronic Technology*, v. 37, Jan. 1960, p. 6-8.

6616* Reducing Amplifier Distortion. Use of Non-Linear Resistors to Correct for Valve Curvature. A vario-losser network composed of nonlinear and linear resistors can be designed to have a transfer characteristic approximately complementary to that of an amplifier. A tandem combination of the network and amplifier produces an over-all transfer characteristic which is significantly more linear than the original. A method for determining the curvature of the transfer characteristic of an amplifier is described and the selection and design of appropriate nonlinear networks are discussed. ***G. W. Holbrook.*** *Electronic Technology*, v. 37, Jan. 1960, p. 13-20.

6617* Travelling-Wave Tube Analogue—Design and Construction. The article shows that by using the lumped-circuit principle and designing the inductance drift-tube structure to provide a given impedance and phase shift, the properties of any traveling-wave tube whose structure possesses equivalent parameters can be simulated, regardless of its actual physical form. ***G. D. Sims and I. M. Stephenson.*** *Electronic Technology*, v. 37, Jan. 1960, p. 20-24.

6618* Installations for, and Results of, Radio-Astronomy. Radio-astronomy makes use of the fact that high-frequency radiations are produced by the bodies in the solar system, in the Milky Way and in the foreign galaxies. In order to receive these radiations very extensive aerial systems as well as high-efficiency receiving apparatus are required. They give sharp focusing and high sensitivity and make it possible to locate sources of radiation at very great distances. *(In German.)* Anla-

gen und Ergebnisse der Radioastronomie. ***Walter Stanner.*** *ETZ, Eletrotechnische Zeitschrift*, v. 12, Ausgabe B, no. 4, Feb. 1960, p. 83-87.

6619* A Note on the Manley-Rowe Energy Relations for Parametric Amplifiers. Manley and Rowe have proved two relations governing the flow of energy in circuits containing nonlinear reactances. The usefulness of the Manley-Rowe relations has been discussed extensively elsewhere. We have merely shown that these relations can be understood in an elementary way, as the requirements of energy conservation under variations of the fundamental frequencies of the given circuit. ***Herbert B. Callen.*** *Franklin Institute, Journal*, v. 269, no. 2, Feb. 1960, p. 93-96.

6620* An Analogy Computer for Problems of the Filter Production. I. Adjusting the Dimensions of Filters According to Given Working Qualities. II. Further Applications. With an analog computer the electrical values of the circuit elements of coupling-free low pass filters (and derived filters) are rapidly determined according to predetermined working parameters. These values are obtained by means of a definite iteration process which was conducted in an adjustable model low pass filter. Further uses of the device are indicated. *(In German.)* Ein Analogiegerät für Aufgaben der Filterentwicklung. I. Die Bemessung von Filtern nach gegebenen Betriebseigenschaften. II. Weitere Anwendungen. ***W. Poschenrieder and H. Sontheim.*** *Frequenz*, v. 13, Dec. 1959, p. 379-385.

6621* Broad Band Adjustment of Horn-Type Parabolic Antennas. The useful band width of a horn-type parabolic antenna used for a broad band directional transmitter installation as well as of a hollow pipe wave guide preferred as a supply circuit, is determined definitely by the transmission from the hollow pipe wave guide to the hopper. A method is given to determine the dimensions of the transmission, which has the same satisfactory high pass properties as the antenna and the supply circuit. *(In German.)* Breitbandanpassung von Hornparabolantennen. ***H. Laub.*** *Frequenz*, v. 13, Dec. 1959, p. 390-397.

6622* Transmission Equations for an Inhomogeneous Cylinder-Symmetrical Transmission System and Their Use on Structural Elements. The formulation of transmission equations for a corresponding cylindrical-symmetrical transmission system leads to a general solution. By using the derivation and resistance values the skin effect of a wire can be indicated as the skin effect of a disc condenser or of a roller type capacitor with longitudinal linings. The impedance of a Ta sintered condenser was given as an example. *(In German.)* Leitungsgleichungen für ein inhomogenes zylindersymmetrisches Leitungssystem und deren Anwendung auf Bauelemente. ***Hermann Heywang.*** *Frequenz*, v. 13, Dec. 1959, p. 397-400.

6623* The Development of Eurovision. Starting from simple beginnings in 1952, the exchange of television programs between European countries has developed rapidly. An international vision network now covers nearly the whole of Western Europe. ***M. J. L. Pulling.*** *Institution of Electrical Engineers, Journal*, v. 6, no. 62, Feb. 1960, p. 96-100.

6624* Protection of Semiconductor Rectifiers. Voltage characteristics, current characteristics, overloads and faults, requirements of fuses for semiconductor rectifiers, protection co-ordination, protection in practice, alternator excitation and control of voltage surges are discussed. *Institution of Electrical Engineers, Journal*, v. 6, no. 62, Feb. 1960, p. 102-104.

6625* Design Considerations for Integrated Electronic Devices. Some fundamental factors affecting the design of integrated electronic devices are discussed, particularly the influence of shrinkage. It is concluded that the considerable advantages of integrated devices, compared to conventional devices, such as very small volume and weight, and reduced number of metallic connections, have to be paid for by higher shrinkage in fabrication. ***J. T. Wallmark.*** *I.R.E. Proceedings*, v. 48, Mar. 1960, p. 293-300.

6626* Perceptron Simulation Experiments. The paper includes a brief review of the organization of simple perceptrons, and theoretically predicted performance curves are compared with those obtained from the simulation programs, in several types of experiments, designed to study "forced" and "spontaneous" learning of pattern discriminations. ***Frank Rosenblatt.*** *I.R.E. Proceedings*, v. 48, Mar. 1960, p. 301-309.

6627* Pulse Compression—Key to More Efficient Radar Transmission. The technique of pulse compression offers a means of increasing the average power available to illuminate radar targets without any loss at the receiver. This is accomplished by transmitting a wide pulse in which the carrier is frequency modulated. ***Charles E. Cook.*** *I.R.E. Proceedings*, v. 48, Mar. 1960, p. 310-316.

6628* Field Effect on Silicon Transistors. The results have been interpreted as being due to changes in surface recombination velocity produced by changes in surface potential. Using this approach, it was possible to calculate the surface recombination velocity of the base region of an operating device directly, without having to go to a filament measuring technique and then extrapolating back to the device. ***B. Schwartz and M. Levy.*** *I.R.E. Proceedings*, v. 48, Mar. 1960, p. 317-320.

6629* A Half-Watt CW Traveling-Wave Amplifier for the 5-6 Millimeter Band. The traveling-wave tube here described represents the first practical CW power amplifier with broadband performance in the millimeter wave band. The electrical and mechanical techniques are described which were found successful in solving the problems peculiar to the high operating frequency. ***H. L. McDowell, W. E. Danielson, and E. D. Reed.*** *I.R.E. Proceedings*, v. 48, Mar. 1960, p. 321-328.

6630* The Propagation of Radio Waves of Frequency Less Than 1 kc. The simplified mode theory of propagation in a wave-guide formed by the earth and a concentric ionosphere of constant height is applied to the experimental observations of Chapman and Macario for the frequency range between 100 cps and 1000 cps. It is demonstrated that the discrepancies between the theory and the nighttime experimental results may be explained by modifying the theory. ***E. T. Pierce.*** *I.R.E. Proceedings*, v. 48, Mar. 1960, p. 329-331.

6631* Maximum Stable Collector Voltage for Junction Transistors. A study is made of the conditions for stability of junction transistors operating in the pre-avalanche breakdown region in order to establish the maximum collector voltage that can be applied to the transistor for stable operation. A method is shown by which this peak voltage can be calculated. ***Robert A. Schmeltzer.*** *I.R.E. Proceedings*, v. 48, Mar. 1960, p. 332-340.

6632* Ionospheric Models as an Aid for the Calculation of Ionospheric Propagation Quantities. Results are given in the form of curves, and a comparison is made with ionograms. The important influence of radiation angle on the MUF (maximum usable frequency) is shown. A large enough number of adequate models (60 to 100) might be valuable to the radio engineer for prediction and design purposes. ***A. H. de Voogt.*** *I.R.E. Proceedings*, v. 48, Mar. 1960, p. 341-346.

6633* Electromagnetic Properties of High-Temperature Air. It is shown that by a suitable normalization of the parameters the electromagnetic properties of plamas may be universally represented in convenient form in either the complex dielectric coefficient plane or the complex propagation constant plane. Next, the electron number densities and electron collision frequencies for air ranging in temperature from 3000 to 12,000 K are illustrated. ***M. P. Bachynski, T. W. Johnston, and I. P. Shkarofsky*** *I.R.E. Proceedings*, v. 48, Mar. 1960, p. 347-356.

6634 Time-Frequency Scanning in Narrow-Band Speech Transmission. Sampling in both time and frequency offers a third major possibility which should be investigated. For this study a narrow-band speech transmission system was constructed which scans the time-frequency plane. The system scans in either a sinusoidal or in a sawtooth manner over a frequency range of 200 to 7000 cps. ***D. L. Subrahmanyam and G. E. Peterson.*** *IRE Transactions on Audio*, v. AU-7, no. 6, Nov.-Dec. 1959, p. 148-160. (TK1 In6.6au Vis.)

6635 Circuits for Three-Channel Stereophonic Playback Derived From Two Sound Tracks. Derivation of a third playback channel from two stereo sound tracks may be accomplished by several means. The center channel may be derived by recombination prior to power amplification; acoustically, after amplification, and in a variety of phase relationships.

Paul W. Klipsch. *IRE Transactions on Audio*, v. AU-7, no. 6, Nov.-Dec. 1959, p. 161-165. (TK1 In6.6au Vis.)

6636 Characteristics of Degenerative Amplifiers Having a Base-Emitter Shunt Impedance. Analysis and measurements led to the discovery of a circuit which would exhibit a high ac input impedance, yet the resistors in the dc base circuit could be kept low to provide good stability. ***William D. Roehr.*** *IRE Transactions on Audio*, v. AU-7, no. 6, Nov.-Dec. 1959, p. 165-169. (TK1 In6.6au Vis.)

6637 Audio Applications of a Sheet-Beam Deflection Tube. A number of unusual audio circuits was developed which make use of a sheet-beam tube, type 6AR8. The 6AR8 tube is a miniature double-plate sheet-beam tube which incorporates a pair of balanced deflectors to direct the electron beam to either of the two plates and a control grid to vary the intensity of the beam. ***J. N. Van Scoyoc.*** *IRE Transactions on Broadcast and Television Receivers*, v. BTR-5, no. 3, Dec. 1959, p. 3-7. (TK1 In6.6b Vis.)

6638 A Drift-Free Direct-Coupled Amplifier Utilizing a Clipper-RC Feedback Loop. A unique drift-free direct-coupled amplifier was developed employing a clipper and an RC integrating circuit in a feedback loop for stability. An existing application of this type of amplifier in an instrument for automatic counting and sizing of aerosol particles is described. A practical general purpose vacuum tube circuit of this amplifier type which was developed is described. ***James N. Van Scoyoc and Ernest S. Gordon.*** *IRE Transactions on Broadcast and Television Receivers*, v. BTR-5, no. 3, Dec. 1959, p. 8-15. (TK1 In6.6b Vis.)

6639 The Application of the Voltage Variable Semiconductor Capacitor in Automatic Sweep Circuits and Signal-Seeking Receivers. The basic method of automatic frequency sweep by charging a voltage variable capacitor is presented and the advantages over mechanically driven tuning capacitors are discussed. Applications in the AM and FM fields, such as domestic and car radio receivers and television sets are proposed. ***J. Black.*** *IRE Transactions on Broadcast and Television Receivers*, v. BTR-5, no. 3, Dec. 1959, p. 16-19. (TK1 In6.6b Vis.)

6640 An Analysis of a Transistorized Class "B" Vertical Deflection System. A practical push-pull direct-driven vertical deflection system can be designed to have a retrace time less than 600 microseconds and a power consumption in the order of 1.5 watts for 90°, 15,000 volt defletcion without decentering problems. ***Zbigniew Wiencek and J. E. Bridges.*** *IRE Transactions on Broadcast and Television Receivers*, v. BTR-5, no. 3, Dec. 1959, p. 20-30. (TK1 In6.6b Vis.)

6641 Improvements in Detection, Gain-Control, and Audio-Driven Circuits of Transistorized Broadcast-Band Receivers. This paper describes the use of a new semiconductor device, a diode-triode transistor, to improve detection, automatic gain control, and audio amplification in transistorized broadcast-band receivers. The use of this device increases the detector efficiency of battery-operated broadcast-band receivers and permits a minimum number of component parts to be used. ***Derek Thorne and Roger V. Fournier.*** *IRE Transactions on Broadcast and Television Receivers*, v. BTR-5, no. 3, Dec. 1959, p. 46-53. (TK1 In6.6b Vis.)

6642 Application of Rotationally Non-Symmetrical Electron Lenses to T.V. Image Reproduction. The first part of the paper deals with a quadrapolar, magnetic lens of rotational non-symmetry used to achieve scan magnification with a television cathode ray tube. The second concerns the development of a negative, electrostatic, gauze lens exhibiting full rotational symmetry which is also used to provide scan magnification. The theory of the rotationally symmetrical divergent lens is developed from an extension of the theory of bipotential lenses. ***Douglas W. Taylor, Norman W. Parker, and H. Neil Frihart.*** *IRE Transactions on Broadcast and Television Receivers*, v. BTR-5, no. 3, Dec. 1959, p. 54-63. (TK1 In6.6b Vis.)

6643 Circuit Aspects of Parametric Amplifiers. The paper considers the lower sideband amplifier which requires only a two frequency description; the signal and the lower sideband. As second case it considers a periodic cascade in which the pump phase is assumed to be varying uniformly. The reactive case is considered specially and orthogonality relations are produced which resemble those of a conventional network chain. ***H. Seidel and G. F. Herrmann.*** *IRE Transactions on Broadcast and Television Receivers*, v. BTR-5, no. 3, Dec. 1959, p. 75-82. (TK1 In6.6b Vis.)

6644 Four Terminal Equivalent Circuits of Parametric Diodes. The equivalent circuits are derived from small signal approximations for the nonlinear dynamic capacitance of a diode. The cases considered involve three frequencies, namely input and output signal frequencies and pumping frequency for converters or input signal frequency, idler and pumping frequencies for amplifiers. ***C. S. Kim.*** *IRE Transactions on Broadcast and Television Receivers*, v. BTR-5, no. 3, Dec. 1959, p. 83-93. (TK1 In6.6b Vis.)

6645 Design Considerations for Space Communication. The purpose of this paper is to delineate the problems involved in space communication, the assumptions that must be made and the technical limitations which determine the communication system that should be used for a particular time frame. Some characteristics for an optimum system are stated. ***J. E. Bartow, G. N. Krassner, and R. C. Riehs.*** *IRE Transactions on Communications Systems*, v. CS-7, no. 4, Dec. 1959, p. 232-240. (TK1 In6.6cs Vis.)

6646 Development Trends in USAF Global Communications Systems. A brief review is given of some of the early communications systems work and the present design philosophy for the 600-voice bandwidth channel, 6000-mile trunk system is discussed. Specific requirements of the ground-based Air Force common-user system are listed and developments intended to provide much of the equipment for this time period 1962-1965 are noted. ***C. A. Strom, Jr. and A. A. Kunze.*** *IRE Transactions on Communications Systems*, v. CS-7, no. 4, Dec. 1959, p. 241-248. (TK1 In6.6cs Vis.)

6647 An Underwater Communication System. Communications between submerged submarines and surface craft require energy to be propagated through sea water. The only practical method for transmitting this energy is by acoustic means. Both FM and AM transmission systems have been used, but for long-range communication, a single-sideband suppressed-carrier transmission system is the only effective way of propagating sound energy. ***Norman D. Miller.*** *IRE Transactions on Communications Systems*, v. CS-7, no. 4, Dec. 1959, p. 249-251. (TK1 In6.6cs Vis.)

6648 Wide-Band Facsimile Transmission Over a 900-Mile Path Utilizing Meteor Ionization. Tests were conducted employing bandwidths up to 110 kc with keying frequencies up to 73 kc, still maintaining the same optical resolution in the facsimile material. With the equipment used in the tests, it appeared that the maximum bit rate for acceptable facsimile was about 48,000 bits per second at 2% duty cycle and about 86,000 bits per second at 1% duty cycle. ***W. H. Bliss, R. J. Wagner, Jr., and G. S. Wickizer.*** *IRE Transactions on Communications Systems*, v. CS-7, no. 4, Dec. 1959, p. 252-256. (TK1 In6.6cs Vis.)

6649 A Very High-Speed Facsimile Recorder. An operating facsimile system is described which is capable of transmitting black and white graphic information at the rate of 24 inches of copy feed per second. The high transmission speed results from the use of individual stylus electrodes for each elemental area along the scanning line and the holding of the video marking signal at each stylus for time intervals approximating the duration of a complete scanning line. ***G. M. Stamps and H. C. Ressler.*** *IRE Transactions on Communications Systems*, v. CS-7, no. 4, Dec. 1959, p. 257-263. (TK1 In6.6cs Vis.)

6650 The NBS Meteor Burst Communication System. For the system under test, the optimum speedup was 40*X*, which produced a daily average channel capacity of about 40 wpm with a character error rate of about 0.0035 (with the best control system settings). ***R. J. Carpenter and G. R. Ochs.*** *IRE Transactions on Communications Systems*, v. CS-7, no. 4, Dec. 1959, p. 263-271. (TK1 In6.6cs Vis.)

6651 White Alice System—Design and Performance. White Alice is an extensive communications network covering the entire state of Alaska. Both telephone and telegraph chan-

nels are provided with capacity for future growth. Radio transmission was chosen for the majority of the routes. For the majority of the links, tropospheric beyond-horizon transmission was used because of the economy and simplifications of maintenance and longistic problems. ***A. L. Durkee, D. Metcalfe, and W. H. Tidd.*** *IRE Transactions on Communications Systems*, v. CS-7, no. 4, Dec. 1959, p. 272-277. (TK1 In6.6cs Vis.)

6652 Practical Considerations in the Design of Minimum Bandwidth Digital Frequency Modulation Systems Using Gaussian Filtering. The Gaussian frequency response is specified and optimum filters for transmitter and receiver are developed. It is shown that for best threshold performance, all receiver filtering should be predetection filtering and that optimum peak deviations under these conditions may correspond to the -4-db point of the IF filter. ***W. L. Glomb.*** *IRE Transactions on Communications Systems*, v. CS-7, no. 4, Dec. 1959, p. 284-290. (TK1 In6.6cs Vis.)

6653 A Study of the Technical and Economic Feasibility for Tropospheric Scatter Circuits in Primary Toll Networks of Underdeveloped Countries. The performance sacrifice for a minimal cost "first in" system and the manner in which design accuracy may be traded against probable propagation reliability are two of the problems discussed. Evaluation of the scatter link may be based on a performance index and data relevant to this are given. ***C. A. Parry.*** *IRE Transactions on Communications Systems*, v. CS-7, no. 4, Dec. 1959, p. 290-295. (TK1 In6.6cs Vis.)

6654 50-kw Antenna Switching System. This paper describes several components and techniques that solve the transmitter-antenna selection problem up to a 50-kw power level. The influence of switching techniques on RF transmission, impedance conversion and antennas are also discussed. ***John W. Smith.*** *IRE Transactions on Communications Systems*, v. CS-7, no. 4, Dec. 1959, p. 295-301. (TK1 In6.6cs Vis.)

6655 The Effects of Low-Noise Techniques on Tropospheric Scatter Communications. This paper defines the expected benefits to be derived from the use of low-noise receiver techniques when applied to tropospheric scatter systems in the 1000 to 2000-mc range. Calculations were made of the expected antenna noise temperatures for "smooth" and "rough" ground locations. ***A. Feiner and D. Savage.*** *IRE Transactions on Communications Systems*, v. CS-7, no. 4, Dec. 1959, p. 302-306. (TK1 In6.6cs Vis.)

6656 Large Signal Bunching of Electron Beams by Standing-Wave and Traveling-Wave Systems. Large signal bunching processes in the presence of space charge are studied by extending techniques used to compute multicavity klystron bunching. Bunching capability of traveling-wave and standing-wave systems is examined by using an assumed spatial and time distribution of electric field, and interesting high degrees of bunching are predicted. ***S. E. Webber.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 4, Oct. 1959, p. 365-372. (TK1 In6.6ed Vis.)

6657 A New Electron Gun for Picture Display With Low Drive Signals. A Pierce-type cathode delivers a collimated parallel beam of 1600 microamperes at 250 volts (microperveance: 0.4). This beam is injected into a cylindrical cavity of appreciable length. It is focused upon a small aperture at the far end using a parabolic axis potential. ***Kurt Schlesinger.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 4, Oct. 1959, p. 377-383. (TK1 In6.6ed Vis.)

6658 Diffused Silicon Nonlinear Capacitors. Diffused Si nonlinear capacitors have been fabricated by solid-state diffusion. These "varactor" diodes may be used as UHF and microwave amplifiers and as harmonic generators. The noise figures of the UHF amplifiers are better than the best noise figures obtainable by present electron-tube techniques. ***A. E. Bakanowski, N. G. Cranna, and A. Uhlir, Jr.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 4, Oct. 1959, p. 384-390. (TK1 In6.6ed Vis.)

6659 The Design and Performance of Grid-Controlled, High-Perveance Electron Guns. The design procedure is used to obtain the desired perveance, beam diameter, and approximate laminar electron flow. A comparison of the electron optics of the gridded and nongridded gun is made. Several models of probe-gridded guns were constructed. The measured characteristics of these guns demonstrate that the advantages of grid control can be obtained with only a minor effect on gun perveance and beam focusing. ***H. E. Gallagher.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 4, Oct. 1959, p. 390-396. (TK1 In6.6ed Vis.)

6660 The Effects of Initial Electron Velocities and Space Charge in Secondary Emission. This paper treats a secondary emitter as a fixed-temperature thermionic emitter with an equivalent work function which depends for its value upon the current density of the incident primary electrons. This permits Langmuir's treatment of the parallel-plane thermionic diode to be applied to secondary emission. ***M. D. Hare.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 4, Oct. 1959, p. 397-404.

6661 Space-Charge Layer Width in Diffused Junctions. This paper outlines a calculation of space-charge layer width in a planar junction made by diffusing an *n* or *p* impurity into a uniformly doped crystal of opposite conductivity type. The collector junction of most drift transistors conforms closely to this model. ***R. M. Scarlett.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 4, Oct. 1959, p. 405-408. (TK1 In6.6ed Vis.)

6662 The Effect of Secondary and Backscattered Electrons in the Parallel-Plane Diode. Separate calculations are carried out to determine the influence of true, low-energy secondary electrons and of higher-energy backscattered electrons released from the anode of the parallel-plane, space-charge limited diode. Both groups depress the potential, increase the field near the anode, and decrease the net diode current by small but appreciable amounts. ***L. A. Harris.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 4, Oct. 1959, p. 413-418. (TK1 In6.6ed Vis.)

6663 Theory of the Amplitron. The Amplitron device is analyzed from a normal mode viewpoint based on predominance of the re-entrant character of the stream; the analysis is therefore valid for devices with short electron recirculation times and moderate signal levels. The Amplitron is a nonlinear, or saturated, amplifier. ***George E. Dombrowski.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 4, Oct. 1959, p. 419-428. (TK1 In6.6ed Vis.)

6664 Low-Noise Klystron Amplifiers. The most obvious difference between the guns for low-noise klystron amplifiers and those typical of low-noise traveling-wave tubes is the higher beam current which is required for adequate klystron gain. A byproduct of this higher current is a wide dynamic range. Several two-cavity, low-noise klystron amplifiers were built for operation in both S-band and C-band. ***Robert G. Rockwell.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 4, Oct. 1959, p. 428-437. (TK1 In6.6ed Vis.)

6665 The Effect of Beam Cross-Sectional Velocity Variation on Backward-Wave-Oscillator Current. Low-voltage helix-type backward-wave oscillators require a starting current that rises to infinity toward the low-frequency end of the tuning range. It is shown that the RF current modulation in the slow space-charge wave is concentrated in the region of the slowest-moving electrons. ***N. C. Chang, A. W. Shaw, and D. A. Watkins.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 4, Oct. 1959, p. 437-442. (TK1 In6.6ed Vis.)

6666 The Cylindrical Field-Effect Transistor. The characteristics of a cylindrical field-effect transistor are derived analytically on the basis of Shockley's theory of the planar field-effect transistor. It is found that the cylindrical device is capable of giving twice the (voltage) amplification factor of that of the planar device. ***H. A. Richard Wegener.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 4, Oct. 1959, p. 442-449. (TK1 In6.6ed Vis.)

6667 Small-Signal Theory of Multicavity Klystrons. A small-signal formulation is developed which is valid for multicavity klystrons with nonideal gaps. The complete one-dimensional description of modulation at the gap is given, including the modifications due to space-charge forces. Stagger-tuned amplifiers are treated by matrix and by scalar methods. ***George R. White.*** *IRE Transactions on Electron Devices*, v. ED-6, no 4, Oct. 1959, p. 449-457. (TK1 In6.6ed Vis.)

6668 Cross Modulation and Nonlinear Distortion in RF Transistor Amplifiers. The measured curves of cross modulation vs. collector bias current show a sharp minimum. This unexpected effect is explained by an extension of the theory, which takes into account previously neglected terms. The explanation is successfully tested by experiments. ***M. Akgün and M. J. O. Strutt.*** *IRE Transactions on Electron Devices*, v. ED-6, no. 4, Oct. 1959, p. 457-467. (TK1 In6.6ed Vis.)

6669 A New Standardized and Calibrated Phonocardiographic System. A phonocardiographic system has been designed and built using standard units of known frequency characteristics. The system is *calibrated*, as the relative and absolute intensity of the signal can be computed from the records' amplitude, given the conversion factor of the transducer and the degree of amplification in decibels. ***A. A. Luisada and R. Zalter.*** *IRE Transactions on Medical Electronics*, v. ME-7, no. 1, Jan. 1960, p. 15-22. (TK1 In6.6m Vis.)

6670 Biological Flow and Process Tracing Using Nuclear and Electron Paramagnetic Resonance. A general discussion of the application of nuclear and electron paramagnetic resonance to determination of blood flow velocities in intact humans is discussed. The feasibility has been proven using mice. The system of measurement essentially utilizes paramagnetic (nonradioactive) tracers. ***J. R. Singer.*** *IRE Transactions on Medical Electronics*, v. ME-7, no. 1, Jan. 1960, p. 23-28. (TK1 In6.6m Vis.)

6671 A Pulse Power Amplifier for Biological Stimulation. A power amplifier designed for use as a biological stimulator is described. It is driven by a dc voltage or a pulse generator with an amplitude of 50 volts. The output power of up to 250 volts and 100 ma is precisely controlled. ***Harry Ludwig.*** *IRE Transactions on Medical Electronics*, v. ME-7, no. 1, Jan. 1960, p. 29-31. (T1 In6.6m Vis.)

6672 A New Approach to the Linear Design and Analysis of Phase-Locked Loops. The root-locus method yields graphs which specify how the transient response changes with signal strength. This method also reveals two thresholds which explain why a small change in signal strength or modulation may cause complete loss of detection. Charts show how the transients vary with various pole-zero patterns for both step and ramp inputs. ***Charles Sinclair Weaver.*** *IRE Transactions on Space Electronics and Telemetry*, v. SET-5, no. 4, Dec. 1959, p. 166-178. (TK1 In6.6r Vis.)

6673 Space-to-Ground Transmissions Beyond the Line-of-Sight Distance. Transmission involving penetration of the *F*-layer, and subsequent ground-to-*F*-layer reflections, is found to be more reliable than transmission, depending upon ducting either along the *F*-layer or between the *E*- and *F*-layers. At a frequency approximately three times the maximum plasma frequency transmission must take place in a direction along which the maximum plasma frequency increases. ***Janis Galejs.*** *IRE Transactions on Space Electronics and Telemetry*, v. SET-5, no. 4, Dec. 1959, p. 179-185.

6674 The Application of Radio Interferometry to Extraterrestial Metrology. The essential building block of an interferometric system, the interferometric link, is discussed, especially with reference to the transmit-receive problem and to the noise problem in a frequency tracking circuit. One form of phase-locked loop is discussed in connection with the latter. Several possible interferometric applications are listed. ***Marcel J. E. Golay.*** *IRE Transactions on Space Electronics and Telemetry*, v. SET-5, no. 4, Dec. 1959, p. 186-193. (TK1 In6.6r Vis.)

6675 An Interplanetary Communication System. There exists a monotonic relationship for every communication system between the received energy required per unit of received information. Proper screening and processing of data before their transmission can increase the amount of useful information received at the expense of other data not so valuable. ***G. E. Mueller and J. E. Taber.*** *IRE Transactions on Space Electronics and Telemetry*, v. SET-5, no. 4, Dec. 1959, p. 196-204. (TK1 In6.6r Vis.)

6676 Deltamodulation for Cheap and Simple Telemetering. Deltamodulation is a simple binary pulse transmission method that can be readily adapted to transmit d.c. signal levels. It is particularly useful where only a few channels are to be sent, and where one per cent accuracy suffices. ***F. K. Bowers.*** *IRE Transactions on Space Electronics and Telemetry*, v. SET-5, no. 4, Dec. 1959, p. 205-208. (TK1 In6.6r Vis.)

6677 Investigation of the Temperature Variation of Noise in Diode and Transistor Structures. Measurements of the white noise of transistors (principally, diffused-base structures) and diodes have been made at temperatures ranging from ~77 K to 300 K for a range of about two decades in injection level, and from 10 kc to 10 Mc. Comparisons of the noise measurements with calculated levels are presented. The Ge transistors show a progressively increasing deviation from the theory as the temperature is decreased, and most of the Si transistors exhibited excess white noise at room temperature and below. ***C. A. Lee and G. Kaminsky.*** *Journal of Applied Physics*, v. 30, Dec. 1959, p. 1849-1855.

6678 Studies of Cold Cathode Discharges in Magnetic Fields. Current densities of the order of half an ampere per square centimeter in various gases were used. For such a discharge, the current to the cathodes is about 75% ionic. Positive ions leaving the discharge by moving across the magnetic field were observed with a mass spectrometer and showed a temperature of about 1 v. Fast electrons from the cathode escape from the discharge across the magnetic field without losing the greater part of their energy. ***John Backus.*** *Journal of Applied Physics*, v. 30, Dec. 1959, p. 1866-1869.

6679 Noise Propagation on Uniformly Accelerated Multivelocity Electron Beams. The characteristics of noise propagation through a multivelocity region with linearly increasing d.c. potential have been calculated using the density-function formulation of Siegman, Watkins, and Hsieh. ***W. M. Mueller and M. R. Currie.*** *Journal of Applied Physics*, v. 30, Dec. 1959, p. 1876-1880.

6680 Effect of Impurity Scattering on the Figure of Merit of Thermoelectric Materials. The thermoelectric figure of merit $z = \alpha^2/\rho k$ is calculated for an extrinsic semiconductor with mixed acoustic-mode lattice scattering and ionized-impurity scattering. The result is compared to the value for pure acoustic-mode scattering. As the amount of ionized-impurity scattering is increased, the figure of merit increases by less than 10% and then falls slowly. ***Roland W. Ure, Jr.*** *Journal of Applied Physics*, v. 30, Dec. 1959, p. 1922-1924.

6681 Effect of Internal Heating on the Breakdown Characteristics of Silicon *p-n* Junctions. ***B. Sentizky and P. D. Radin.*** *Journal of Applied Physics*, v. 30, Dec. 1959, p. 1945-1950.

6682 Heat Treatment Centers and Bulk Currents in Silicon *p-n* Junctions. A set of small-area, alloy, *p-n* junction diodes was made from a slice of heat-treated *n*-type Si. The carrier lifetimes of the diodes were found to be in the range of 2.5×10^{-6} sec to 3.5×10^{-6} sec. Measurements were made of the lifetime and of the current-voltage characteristics in the forward and reverse directions as a function of temperature from room temperature to 165 C. An analysis of the results and, in particular, the correlation of current flow with lifetime values, showed that for the diodes with the shortest lifetimes, centers situated 0.48 ev at O K from either the conduction or valence bands were responsible for large space-charge currents. For the diodes with lifetimes in the microsecond range, surface leakage currents were predominant. ***D. J. Sandiford.*** *Journal of Applied Physics*, v. 30, Dec. 1959, p. 1981-1986.

6683* Night-Time Equatorial Propagation at 50 Mc/s First Results From an IGY Amateur Observing Program. During IGY the American Radio Relay League collected radio amateur reports of 50- and 144-Mc/s ionospheric propagation, evaluated them, and transcribed them onto punched cards. Analysis of 50-Mc/s equatorial intercepts, begun this summer at Stanford University, has revealed three apparently related types of nocturnal, low-latitude propagation. ***M. P. Southworth.*** *Journal of Geophysical Research*, v. 65, no. 2, Feb. 1960, p. 601-607.

6684* Short-Wave Fadeouts Without Reported Flares. Sacramento Peak flare patrol films were re-examined for those days on which short-wave fadeouts (SWF's) had occurred during patrol times without reported flares. Fifteen such fade-

outs were reported during the IGY period. Upon re-examination of the films, 12 of the SWF's were found to be in close time association with outstanding $H\alpha$ events, usually in the nature of pronounced plage brightenings. ***Howard DeMastus and Marion Wood.*** *Journal of Geophysical Research*, v. 65, no. 2, Feb. 1960, p. 609-611.

6685* Parametric Amplification. Principles are reviewed in physical terms and passes from simple circuit amplifiers to the more complex Suhl-types of amplifier. Mention is made of some of the directions in which research is proceeding. ***K. W. H. Stevens.*** *Journal of Scientific Instruments*, v. 37, Jan. 1960, p. 1-5.

6686* The Theory of Semiconductors. ***R. J. Elliott and P. C. Banbury.*** *Metallurgical Reviews*, v. 4, no. 15, 1959, p. 257-308.

6687 Effects of Polarized Light on Photocurrents and Photovoltages in ZnS. The anomalous short circuit photocurrents in ZnS have been measured using polarized light. In spite of the fact that for a given wavelength, light polarized perpendicular to the c axis is more strongly absorbed than light polarized parallel to the c axis, there are wavelength regions in which the absolute magnitude of the short circuit photocurrents are smaller for perpendicularly polarized light. The data are consistent with a double valence band model. ***G. Cheroff, R. C. Enck, and S. P. Keller.*** *Physical Review*, v. 116, 2nd ser. no. 5, Dec. 1, 1959, p. 1091-1093.

6688 Sauter Theory of the Photoelectric Effect. Results of Sauter are expressed in the form of a transition matrix which determines the photoelectric effect cross section for arbitrary X-ray polarization and arbitrary initial and final orientations of the electron spin. The structure of the matrix elements accounts for curious properties of the cross section in terms of interference between orbital and spin currents. ***U. Fano, K. W. McVoy, and James R. Albers.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1147-1156.

6689* Medium Wave Single Wire Receiving Antenna of a Traveling Wave. The directional properties and parameters of this type of antenna were analyzed and formulas for the calculation of the parameters and a complete electric calculation of some variants were produced. (*In Russian.*) Priëmnaia srednevolnovaia odnoprovodnaia antenna begushcheĭ volny. ***S. P. Belousov and V. G. Iampol'skiĭ.*** *Radiotekhnika*, v. 15, no. 1, Jan. 1960, p. 16-25.

6690* Effects of Frequency- and Amplitude-Modulated Waves on Linear Systems. According to the method suggested, the output voltage is calculated as the product of the input voltage by the dynamic coefficient of transmission of the system, which depends not only on the frequency of the input voltage, but also on the products of frequency and amplitude as a function of time. *(In Russian.)* Voizdeĭstvie chastotno- i amplitudno-modulirovannykh kolebaniĭ na lineĭnye sistemy. ***I. T. Turbovich.*** *Radiotekhnika*, v. 15, no. 1, Jan. 1960, p. 30-34.

6691* A Contribution to the Calculation of Noises in Radioreceivers. On the basis of the reciprocity theorem and of the theorem of the independence of the noise level of linear circuits from the value of the output load, the basic relationships for the calculation of the noises of a radioreceiver, including the antenna-feeder system were given. *(In Russian.)* K raschëtu shumov radiopriëmnikov. ***I. M. Aibinder.*** *Radiotekhnika*, v. 15, no. 1, Jan. 1960, p. 48-59.

6692 The Reflexion of Radio Waves From a Stratified Ionosphere Modified by Weak Irregularities. II. The results of an earlier paper are applied to an ionosphere containing weak random irregularities, specified only statistically. It is supposed that the shape of the irregularities is described by a Gaussian autocorrelation function, and that their intensity varies in a known way with height. Possibilities of obtaining slow and rapid fading characteristics from forward and back scatter by the irregularities are considered briefly. ***M. L. V. Pitteway.*** *Royal Society, Proceedings*, v. 254, ser. A, Jan. 19, 1960, p. 86-100.

See also: **6799** (thermoelectric generation); **6865** (Al Sb semiconductors).

ENGINEERING ECONOMICS

6693* Statistics and Education for Business. Discusses changes advisable in statistics courses in colleges and graduate schools. ***Maurice W. Lee.*** *American Statistician*, v. 14, no. 1, Feb. 1960, p. 16-19.

6694 "Productivity" Means Many Things. *Chemical Engineering*, v. 67, Feb. 22, 1960, p. 72 + 1 page.

6695* Estimating Future Costs. Some tips on how to anticipate the costs of developing and operating chemical process plants. ***William Copulsky and Rudolf Cziner.*** *Chemical Engineering Progress*, v. 56, Feb. 1960, p. 46-49.

6696* Cost Procedures and Control. The cost and estimating information are necessary fundamentals for control. When the various data have been collected and analyzed, the Control Group can then produce a project status report for management. The information should be collected in the following sequence: materials, manpower, cost, progress, and conclusions. ***Donald G. Adkins and Fred S. Radwanski.*** *Cost Engineering*, v. 5, no. 1, Jan. 1960, p. 8-15.

6697* Cost Literature—1959. A subject listing for costs in all fields of engineering. *Cost Engineering*, v. 5, no. 1, Jan. 1960, p. 18-39.

6698 Fringe Benefits. Covers all common forms of fringe benefits and some uncommon ones. Presents the points of view of all the interested parties-employers, unions, employees and beneficiaries—and discusses the social and economic impact, or lack of impact, of the more important schemes. ***Francis M. Wistert.*** 155 pp. 1959. Reinhold Publishing Corp., New York. (HD4932 W75f)

6699* Management Must Be Made Accountable. Separation of ownership from management constitutes a serious threat of free enterprise. ***Ernest Dale.*** *Harvard Business Review*, v. 38, no. 2, Mar.-Apr. 1960, p. 49-59.

6700* Return on Investment: Fit the Method to Your Need. Problems as varied as make-or-buy and the appraisal of long-range trends in efficiency require different computation techniques. There is no one best way for all situations. ***Edward A. Ravenscroft.*** *Harvard Business Review*, v. 38, no. 2, Mar.-Apr. 1960, p. 97-109.

6701* Incentive Financing — a New Opportunity. For both institutional investors and business borrowers, hampered by more than the usual risk, this new approach offers new rewards. ***Charles M. Williams and Howard A. Williams.*** *Harvard Business Review*, v. 38, no. 2, Mar.-Apr. 1960, p. 123-134.

6702 Flow of Fluids. Increasing attention is being given to solids transport by fluid power. Recent literature on the flow of fluids emphasizes developments in immediate engineering applications. ***Murray Weintraub.*** *Industrial and Engineering Chemistry*, v. 52, Mar. 1960, p. 257-261.

6703* Norway's Flourishing Aluminum Industry. Primary output rose 19% of 145,000 metric tons last year. Capacity will hit 230,000 tons in next few years, making Norway Europe's biggest Al producer. ***Nils Ramm.*** *Modern Metals*, v. 16, no. 1, Feb. 1960, p. 38.

FLUID MECHANICS

6704 Thermo-Magnetic Effects in Liquids. The results of an experiment on the effect of the magnetic field on the rate of cooling of Hg and H_2O is presented. The rate of cooling was faster in the magnetic field for both liquids. ***R. C. Saxena, J. N. Tandon, and S. P. Talwar.*** *Nature*, v. 185, Jan. 16, 1960, p. 158-159.

6705 Hydrodynamic Aspects of Boiling Heat Transfer. Review of nucleate boiling; problem of bubble growth; hydrodynamic aspects of nucleate boiling. ***Novak Zuber.*** *U. S. Atomic Energy Commission, AECU-4439*, June 1959, 195 pp. (UF767 U3au Contin.)

6706 West Virginia Statistical Handbook. Revised Edition. A concise, readily usable sourcebook of economic statistics for the state and its subdivisions. It was designed primarily for businessmen, teachers, editors, and others who have frequent need for West Virginia statistics, but may lack the time or facilities to search widely-scattered sources for this information. *West Virginia University, Business and Economic Studies,* v. 7, May 1959, 143 pp. (HC107.W4 W52.1b Vis.)

6707 Work Measurement. The purpose of this book is to present the fundamental principles and techniques of work measurement and their practical application to industrial problems of today. ***Virgil H. Rotroff.*** 203 pp. 1959. Reinhold Publishing Corp., New York. (T60.W6 R49w)

6708* Flow Measurement of a High-Temperature Fluid With a Venturi Meter. The flow measurement system described here and used on a Na circuit was found to be reliable, easy to use and the results were reproducible. It is independent of temperature up to 550 F at the transmitters, which is equal to a measured temperature of 750 F at the venturi. ***R. C. Cairns and P. Fisher.*** *British Chemical Engineering,* v. 5, Feb. 1960, p. 103-105.

6709* Comparison Between Trapezoidal and Parabolical Channels. Shows that parabolical channels have better hydraulic characteristics than optimal trapezoidal ones. In this hypothesis the relation between slopes of the two channels was established, and the influence of y and h_p/h_t parameters was shown. *(In French.)* Comparaison entre les canaux trapézoïdaux et les canaux paraboliques. ***Stefan Zarea.*** *Bucharest, Institutul Politehnic, Buletinul,* v. 20, no. 1, Jan.-Mar. 1958, p. 43-50.

6710 Sloshing of Liquids in Circular Canals and Spherical Tanks. Theoretical calculations are made of the natural modes and frequencies of small-amplitude sloshing of liquids in partially filled circular canals and spherical tanks. An integral-equation approach is used to analyze the circular canal for arbitrary depth of liquid. ***Bernard Budiansky.*** *Journal of the Aero/Space Sciences,* v. 27, Mar. 1960, p. 161-173.

6711 Absorption of Plasma Waves. Propagation of waves through a plasma in which the density and/or magnetic field strength are slowly varying functions of position, is discussed. ***Thomas H. Stix.*** *Physics of Fluids,* v. 3, no. 1, Jan.-Feb. 1960, p. 19-32.

6712* The Electronic Measurement of Flow Rate and Turbulence. A hot-wire anemometer for constant wire temperature was developed for measuring the flow rate of gases and of turbulence spectra. In conjunction with an oscillograph the small dimensions of the wire and the selected amplifier and measuring equipment enable almost punctiform measurements to be obtained for the gas velocity in a wide range, in addition to metering turbulence at frequencies up to and exceeding 30 kc/s. *(In German.)* Die elektronische Messung der Strömungsgeschwindigkeit und der Turbulenz. ***Rudolf F. Staritz.*** *VDI Zeitschrift,* v. 102, no. 3, Jan. 21, 1960, p. 94-97.

FOOD TECHNOLOGY

6713* Nutrition Research for the Space Traveler. ***Beatrice Finkelstein.*** *American Dietetic Association, Journal,* v. 36, Apr. 1960, p. 313-317.

6714* Treatment of Multiple Sclerosis With a Low-Fat Diet. Patients with multiple sclerosis have been observed on a low-fat diet for a period of nine-and-a-half years. The frequency and severity of exacerbations in all cases were significantly reduced, and the performance of patients first treated in the early phase of the disease was improved or unaltered during this period. ***Roy L. Swank.*** *American Dietetic Association, Journal,* v. 36, Apr. 1960, p. 322-325.

6715 Food America's Biggest Business. ***Pauline Arnold and Percival White.*** 338 pp. 1959. Holiday House, Inc., New York. (HD9005 Ar65f)

6716* Compatibility of Plant, Animal and Microbiological Proteases. The significance of protease incompatibility is inferred in those commercial applications where combinations of proteases may be used such as in meat tenderizing formulas and chillproofing compounds for the brewing industry. ***Vincent Bavisotto, Carl Miller, and Ronald Dewane.*** *Food Research,* v. 25, no. 1, Jan.-Feb. 1960, p. 58-63.

6717* Observations on the Behavior of Meat Pigments in Solutions. ***Mina Glidden, Margaret Mangel, Katya Singleton, and Miriam Stone.*** *Food Research,* v. 25, no. 1, Jan.-Feb. 1960, p. 127-138.

6718* The Growth, Breeding and Longevity of Rats Fed Irradiated or Non-Irradiated Pork. Irradiated pork held at room temperature, or control pork which was non-irradiated but was held in the frozen state, was fed ad libitum to rats over a four-generation, two-year study. The pork was fed as 35% of the dry weight of the diet. The remainder of the diet was non-irradiated and was considered nutritionally adequate. No statistical differences were obtained in growth, breeding and longevity among any of the groups. ***Edward C. Bubl and Joseph S. Butts.*** *Journal of Nutrition,* v. 70, no. 2, Feb. 1960, p. 211-218.

6719* An Unidentified Water-Soluble Factor in Alfalfa Which Improves Utilization of Vitamin A. ***Benjamin H. Ershoff and H. J. Hernandez.*** *Journal of Nutrition,* v. 70, no. 3, Mar. 1960, p. 313-320.

6720* Nutritional Studies With the Guinea Pig. VI. Tryptophan (With Ample Dietary Niacin). The requirement for complete eye protection and for good growth is more than 0.16%, but possibly somewhat less than 0.2%. ***Mary Elizabeth Reid and Ludwig Von Sallmann.*** *Journal of Nutrition,* v. 70, no. 3, Mar. 1960, p. 329-336.

6721* The Availability of Lysine in Wheat, Flour, Bread and Gluten. The availability of lysine in wheat, flour, and bread was 75, 72, and 76%, respectively, with the gluten basal diet. ***W. K. Calhoun, F. N. Hepburn, and W. B. Bradley.*** *Journal of Nutrition,* v. 70, no. 3, Mar. 1960, p. 337-347.

FUELS AND COMBUSTION

6722* Proportional Sampling System for the Collection of an Integrated Auto Exhaust Gas Sample. ***John C. Chipman and Morgan T. Massey.*** *Air Pollution Control Association, Journal,* v. 10, no. 1, Feb. 1960, p. 60-69.

6723* Problems Associated With Contaminated Jet Fuels. ***Henry W. Schab.*** *American Society of Naval Engineers, Journal,* v. 72, no. 1, Feb. 1960, p. 41-59.

6724 Hydrogen for the Space Age. ***Richard J. Coar and Charles H. King, Jr.*** *Astronautics,* v. 5, Mar. 1960, p. 26 + 4 pages.

6725* Considerations on the Combustion Within a Moving Gas Mixture. A study of combustion phenomena of a moving gas mixture, for two-dimensional and axis-symmetrical flows, the combustion being started from the walls. The velocity distribution of the burned gas is almost linear for two-dimensional flow and parabolic for the axis-symmetrical one. By using the above mentioned facts one determines the variation of the motion parameters for both constant and variable cross section of the combustion chamber. *(In Romanian.)* Considerații asupra studiului combustiei intr-un amestec de gaz în mișcare. ***V. N. Constantinescu.*** *Bucharest, Institutul Politehnic, Buletinul,* v. 20, no. 1, Jan.-Mar. 1958, p. 23-41.

6726 Radioactive Tracers Find Jet Fuel Flow Rates. Simultaneous gating of oscillator and radiation detector permits recording of flow rate of jet fuel containing radioactive tracer. Reliable transistor circuit can be used for other time-interval measurements. ***J. D. Keys and G. E. Alexander.*** *Electronics,* v. 33, no. 8, Feb. 19, 1960, p. 58-59.

6727* Chemical Structure and Properties of Coal. XXV. The Carbonization of Coal Models. ***P. M. J. Wolfs, D. W. van Krevelen, and H. I. Waterman.*** *Fuel,* v. 39, no. 1, Jan. 1960, p. 25-38.

6728* Mechanisms of Coal Pyrolysis. I. On the Nature and Kinetics of Devolatilization. ***N. Berkowitz.*** *Fuel,* v. 39, no. 1, Jan. 1960, p. 47-58.

6729* Handling and Burning Slurry. Low grade fuels may be burnt economically if the right type of equipment is installed. Describes stokers which are able to burn wet-pond slurry. *Fuel Efficiency,* v. 8, Jan. 1960, p. 25-26.

6730* Combustion Researches. New Information on Heat Transfer by Radiation From Flames in Industrial Furnaces. Emissivity of oil flames was studied and the value of ϵ was increased by the addition of C particles to the oil. The gas temperature was measured at the flame axis by a suction pyrometer. *Fuel Efficiency,* v. 8, Feb. 1960, p. 28-30.

6731* Fuels, Engine Conditions and Diesel Smoke. Examined the tendency of many different fuels to produce blue and black smoke in two automotive diesel engines. ***J. B. Durant and Lamont Eltinge.*** *Gas and Oil Power,* v. 55, no. 660, Jan. 1960, p. 19-21.

6732 The Kinetics of Carbon Gasification. The reaction of C with O and with water vapor is discussed. ***J. D. Blackwood.*** *Industrial Chemist,* v. 36, Feb. 1960, p. 55-60.

6733* Centrifugal Purification of Oils for Marine Service. Development of centrifuge types applicable to the purification of marine oils is traced from the batch units to the fully continuous self-cleaning machines. ***M. E. O'Keeffe Trowbridge.*** *Institute of Marine Engineers, Transactions,* v. 72, Jan. 1960, p. 1-22.

6734 Development of a Molar Volume Equation Suitable for the Structural Analysis of Hydrocarbons. An equation has been developed which expresses the molar volume of 130 pure hydrocarbons prepared by API Project 42 in terms of five structural groups. This equation is intended for the structural analysis of hydrocarbons and has been discussed in this regard. ***M. L. Boyd and D. S. Montgomery.*** *Institute of Petroleum, Journal,* v. 45, Dec. 1959, p. 345-358.

6735* A Method for Establishing Normal Variations in Coal Quality. Simplified procedure readily identifies abnormal variations in quality of coal delivered. By relating range of normal variations with satisfactory boiler performance, a more precise determination of optimum coal characteristics can be obtained. ***Gregory Gould.*** *Plant,* v. 21, Feb. 1960, p. 36-38.

6736 Anthracite Gas-Producer Tests at a Brick Plant. Presents the results and a description of producer and periodic-kiln equipment, operating procedures, and labor requirements. ***R. F. Tenney, J. D. Clendenin, and W. S. Sanner.*** *U. S. Bureau of Mines Report of Investigations* 5556, 25 pp. (TN21 Un3r Vis.)

6737 Gasification of Pulverized Coal at Atmospheric Pressure. ***G. R. Strimbeck, et al.*** *U. S. Bureau of Mines Report of Investigations* 5559, 68 pp. (TN21 Un3r Vis.)

See also: **6336** (desulfurization of gases); **6340** (*n*-heptane isomerization).

GEOLOGY, GEOPHYSICS, MINERALOGY, AND MINING ENGINEERING

6738* Minimum Conditions for Migration of Oil in Water-Wet Carbonate Rocks. ***Bert C. Aschenbrenner and Charles W. Achauer.*** *American Association of Petroleum Geologists, Bulletin,* v. 44, Feb. 1960, p. 235-243.

6739 Distribution of Precipitable Water Vapor Over the Continental United States. The average precipitable water over the U. S. is found to be 1.75 cm and to range from 0.94 cm in Feb. to 2.99 cm in July. Monthly and yearly averages for the period 1946 to 1956 indicate that the yearly and over-all area amounts of precipitable water are rather stable. ***Clayton H. Reitan.*** *American Meteorological Society, Bulletin,* v. 41, Feb. 1960, p. 79-87.

6740* Water Resources and Conservation. Discusses the urgent need for water conservation in Australia. *Australasian Engineer,* v. 52, Dec. 1959, p. 75-77.

6741* The Canadian Mineral Industry in Restrospect. The mineral industry, its progress, achievements and problems, protectionism are discussed. The mining and further processing of U, Ni, Pb and Zn, Cu, Fe ore, Au, Mo, Ag, Ti, Co, Mg, Al, potash, S, salt, gypsum, asbestos, coal, petroleum, and natural gas are discussed in detail. ***W. Keith Buck, et al.*** *Canadian Mining Journal,* v. 81, Feb. 1960, p. 132-165.

6742* General Features of the Conformable "Pyritic" Orebodies. II. Mineralogy. The term "pyritic" for deposits is in many cases a misnomer, as two quite distinct ore types are involved. One is a banded pyritic sphalerite-galena-chalcopyrite ore, while the other is non-banded and is composed essentially of pyrrhotite and chalcopyrite. ***R. L. Stanton.*** *Canadian Mining and Metallurgical Bulletin,* v. 53, no. 574, Feb. 1960, p. 66-74; *Canadian Institute of Mining and Metallurgy, Transactions,* v. 63, 1960, p. 28-36.

6743* The Occurrence of Massive Sulphide Deposits in Canada. I. Introduction. II. Massive Sulphide Deposits in Newfoundland. III. Massive Sulphide Deposits in Nova Scotia. Pyrite-sphalerite-chalcopyrite-galena mineralization in pre-carboniferous volcanics and sediments; pyrite-sphalerite-galena mineralization in Mississippian sediments; sphalerite-pyrite-pyrrhotite mineralization in precarboniferous crystalline limestone are discussed. I. ***J. E. Gill.*** II. ***D. M. Baird.*** III. ***B. J. Keating.*** *Canadian Mining and Metallurgical Bulletin,* v. 53, no. 574, Feb. 1960, p. 75-87; *Canadian Institute of Mining and Metallurgy Transactions,* v. 63, 1960, p. 37-49.

6744* Technology Mining Exploration. Airborne and ground geophysics, exploration geology and drilling are discussed. Mining methods, block caving operations, shrinkage stoping, production drilling and blasting, development practices, shaft sinking, haulage, hoisting, mine exploration, open pit and other problems are discussed. ***D. W. Smellie, et al.*** *Canadian Mining Journal,* v. 81, Feb. 1960, p. 166-187.

6745 Origin of the Elements in Stars. ***F. Hoyle.*** *Chemical Society, Proceedings,* 1960, Jan., p. 1-9.

6746* Bitumen in Shaft Construction. Recently, the Netherlands State Mines have constructed two new concrete shafts with an approximately 10 cm thick bitumen layer between the cladding and the earth. Several new shafts of another type are also to be provided with this type of bitumen layer. Shows how the correct composition for the mixture can be selected from knowledge of the mechanical properties of the bituminous material. (*In German.*) Bitumen im Schachtbau. ***R. E. Kerkhoven.*** *Chemie-Ingenieur-Technik,* v. 32, Jan. 1960, p. 40-44.

6747 Thin-Seam Continuous Mining Pays Off at TCI. Thin-seam mining at Tennessee Coal & Iron Div., U. S. Steel Corp. has practically become synonymous with high cost coal; however, this coal constitutes some of the highest quality coking coal in the Birmingham area. Since thin seams constitute about one-third of TCI's coking coal reserves and this coal is needed for blending with other coals to supply a satisfactory feed for the coke ovens, it has been deemed essential that thin seam production continue. *Coal Age,* v. 65, Feb. 1960, p. 98-102.

6748* Foaming Agents Spur Use of Air Drilling. Sloughing shales are a deterrent to wider use of foam drilling. There is a real need, too, for a foamer that is unaffected by crude oil. ***W. C. Goins, Jr. and H. J. Magner.*** *Drilling,* v. 21, Feb. 1960, p. 65-67.

6749* Formation Fractures Propped Effectively With Walnut Shells. A search of readily available organic materials led to the use of crushed black-walnut shells as a propping agent. Rounded shell material is used. ***J. L. Huitt, B. B. McGlothlin, and J. F. McDonald.*** *Drilling,* v. 21, Feb. 1960, p. 68.

6750* High-Calcium Drilling Fluid Represses Clay Hydration. Four field tests using high-calcium mud were conducted in an area noted for shale problems. Results thus far indicate a reduction in hole enlargement, improved drilling rate, and

less shale hydration. ***P. H. Monaghan and J. L. Gidley.*** *Drilling*, v. 21, Feb. 1960, p. 70 + 2 pages.

6751* Primary Mineralization of Uranium-Bearing "Siliceous Reef" Veins in the Boulder Batholith, Montana. I. The Host Rocks. ***Harold D. Wright and Barrie H. Bieler.*** *Economic Geology*, v. 55, no. 1, Jan.-Feb. 1960, p. 56-72.

6752* Meteorological Measuring Technique in the Free Atmosphere. To explain the working conditions to which the meteorological measuring instruments known as radiometeorographs are subjected in the free atmosphere, facts concerning the distribution of temperature and density are discussed. The influence of solar radiation on temperature measurement is explained. *(In German.)* Meteorologische Messtechnik in der freien Atmosphäre. ***Max Hinzpeter.*** *ETZ, Elektrotechnische Zeitschrift*, v. 12, Ausgabe B, no. 4, Feb. 1960, p. 73-77.

6753* Some Physical and Chemical Properties of Vitrains Associated With Uranium. ***S. Ergun, W. F. Donaldson, and I. A. Breger.*** *Fuel*, v. 39, no. 1, Jan. 1960, p. 71-77.

6754* The Rhodium, Silver and Indium Content of Some Chondritic Meteorites. By neutron activation analysis the Rh, Ag, and In content of five chondritic meteorites have been determined. ***U. Schindewolf and M. Wahlgren.*** *Geochimica et Cosmochimica Acta*, v. 18, nos. 1-2, Jan. 1960, p. 36-41.

6755* Scandium, Chromium and Europium in Stone Meteorites by Simultaneous Neutron Activation Analysis. Analyses of five chondrites by simultaneous neutron activation yielded results indicating cosmic abundances of 32, 6400 and 0.078 (per 10^6 Si atoms) for Sc, Cr, and Eu, respectively, using Urey's assumptions. ***G. L. Bate, H. A. Potratz, and J. R. Huizenga.*** *Geochimica et Cosmochimica Acta*, v. 18, nos. 1-2, Jan. 1960, p. 101-107.

6756* Studies in the Geochemistry of Gold. II. The Gold Content of Some Basic and Ultrabasic Rocks and Stone Meteorites. Analyses by the neutron activation method reveal about 0·002 ppm Au in two basalts from the British Tertiary igneous province and in one recent Hawaiian flow. From 0.001 to 0.01 ppm Au has been found in dunites and olivine-rich nodules included in basalts, the majority of results being appreciably higher than for the basalts analyzed. ***E. A. Vincent and J. H. Crocket.*** *Geochimica et Cosmochimica Acta*, v. 18, nos. 1-2, Jan. 1960, p. 143-148.

6757* Some Growth Characteristics of Synthetic Diamonds: A Distinction Between Natural and Synthetic Diamond. Discusses characteristic features that can be observed on the faces of natural and synthetic diamond crystals. The synthetic crystals dealt with are all of the GE type. ***S. Tolansky and I. Sunagawa.*** *Industrial Diamond Review*, v. 20, Jan. 1960, p. 7-13.

6758 Variation of Fluid Properties With Elevation in High-Relief Oil Reservoirs. Volumetric data and recently acquired thermal-diffusion data permit computations which show that the gravitational segregation and the geothermal segregation are opposite in sign and are essentially equal in magnitude for the methane-butane system at its bubble point under the specified conditions of composition, pressure, and temperature gradient. ***J. G. Roof.*** *Institute of Petroleum, Journal*, v. 45, Dec. 1959, p. 373-379.

6759* The 'Tellurometer' System—New Applications to Geodesy and Hydrography. New applications; theoretical considerations: movement, range and accuracy; hydrographic applications; airborne applications are discussed. ***R. D. Smith.*** *Journal of Geophysical Research*, v. 65, no. 2, Feb. 1960, p. 418-429.

6760* Some Spectral Studies of the Aurora. Spectra, taken routinely since 1941, give a continuous spectral record of the north sky for every night. Special emphasis was given the study of H, with two main results: H appears in the early part of an aurora, and may be gone before the visual display is over. ***R. C. Bless, C. W. Gartlein, and G. Sprague.*** *Journal of Geophysical Research*, v. 65, no. 2, Feb. 1960, p. 565-570.

6761* Radar Indications of a Precipitation-Lightning Relationship in New England Thunderstorms. Thunderstorm electrical activity in terms of surface-observed lightning-stroke rate is related to radar-reflectivity maxima above the O C level and to vertical profiles of radar reflectivity. This, and the fact that it is also related to the incidence of hail at the surface, lends support to a previously stated theory of charge generation and separation by Workman and Reynolds. ***Charles Reere Shackford.*** *Journal of Meteorology*, v. 17, no. 1, Feb. 1960, p. 15-19.

6762* Rotation of Dust Devils. Observes that large dust devils rotate cyclonically, at least near Tucson, Arizona. This implies that the dust-devil is a central feature of a convective cell whose horizontal radius is frequently a mile. A graph of wind speed versus vortex radius is included. ***H. B. Brooks.*** *Journal of Meteorology*, v. 17, no. 1, Feb. 1960, p. 84-86.

6763* Floating Drilling-Barge Operations. The successful operation of floating drilling barges has established that this type equipment will find general acceptance for drilling and completing offshore wells. The floating barge supplements, rather than replaces, the more conventional offshore equipment and allows a much broader scope of operations. ***K. M. Nicolson.*** *Journal of Petroleum Technology*, v. 12, Feb. 1960, p. 18-22.

6764* Use of Inverted-Emulsion Mud Proves Successful in Zones Susceptible to Water Damage. Extreme difficulties in well completions in Pennsylvanian age sands in Central Oklahoma led to the use of an inverted-emulsion mud for drilling-in, completion and workover operations in this area. Offers no advantage in limestone or dolomite completion. ***Glenn A. Trimble and M. D. Nelson, Jr.*** *Journal of Petroleum Technology*, v. 12, Feb. 1960, p. 23-30.

6765* Laboratory Studies of Pilot Water Floods. Procedures have been developed to study the performance characteristics of unconfined pilot water floods using scaled laboratory models. Relationships between the oil recoveries of pilots and large-scale floods have been established. ***R. L. Dalton, Jr., L. A. Rapoport, and C. W. Carpenter, Jr.*** *Journal of Petroleum Technology*, v. 12; *American Institute of Mining and Metallurgical Engineers, Transactions*, v. 219, Feb. 1960, p. 24-30.

6766* The Mary Kathleen Uranium Project. A description is given of U mining and milling methods employed at the Mary Kathleen Mine in the Cloncurry-Mt. Isa district of Queensland. After a brief historical outline of the development of this important property, this first article deals with the geology of the deposit and opencast mining operations. ***A. Nelson.*** *Mine & Quarry Engineering*, v. 26, Feb. 1960, p. 46-54.

6767* Boron. A summary of the occurrence and production of B minerals, with details of present and possible future uses to which this metal and its compounds may be put is given. ***T. H. H. Skeet.*** *Mine & Quarry Engineering*, v. 26, Feb. 1960, p. 60-66.

6768 Water Laws Related to Mining. ***Wells A. Hutchins.*** *Mining Engineering*, v. 12, Feb. 1960, p. 153-158.

6769 Energy Input and Size Distribution in Comminution. ***R. Schuhmann, Jr.*** *Mining Engineering*, v. 12, Feb. 1960, p. 161-164.

6770* Dust and Gas Between the Earth and the Sun. ***R. O. Redman.*** *Observatory*, v. 79, Oct. 1959, p. 172-181.

6771 Lab Tests Show That CO_2 Scores Highest in Reducing Oil Viscosity. Production of viscous crude may be made more efficient by injection of certain gases that have a marked effect on crude viscosity and density. ***Lee R. Dickerson and George W. Crawford.*** *Oil and Gas Journal*, v. 58, no. 8, Feb. 22, 1960, p. 96-98.

6772 Suppose We Drilled a 50,000-Footer . . . Could We Produce It? Servicing the well, and producing it, are almost out of the question now unless new materials are made available. *Oil and Gas Journal*, v. 58, no. 8, Feb. 22, 1960, p. 111 + 5 pages.

6773 How Oil-Emulsion Muds Can Lead to Log-Interpretation Errors. Inaccurate determination of electrical properties of mud, mud filtrate, and mud cake can introduce errors that will give false porosity and saturation answers. Here are some

suggestions to follow if your log interpretation is to become more reliable. ***Norman Lamont.*** *Oil and Gas Journal*, v. 58, no. 9, Feb. 29, 1960, p. 66-67.

6774* Drilling Fluids: A Current Review. I. Functions and properties required of drilling fluids in their modern context. ***G. K. Jones.*** *Petroleum*, v. 23, Feb. 1960, p. 43-47.

6775* Effect of CMC-Viscosity on Drilling Mud Properties. ***G. J. J. Nijhoff and E. F. Zaalberg van Zelst.*** *Petroleum*, v. 23, Feb. 1960, p. 49-52.

6776* Drilling Fluids: a Current Review. II. Examples of specialized fluids are given together with an account of field testing procedures. ***G. K. Jones.*** *Petroleum*, v. 23, Mar. 1960, p. 101-104.

6777 The Effect of Added Titanium on the Magnetic Behaviour of Haematite. Shows that the solution of about 1% Ti in α-hematite does not suppress the rapid change in either the susceptibility or the parasitic ferromagnetism which are associated with the change in the direction of the antiferromagnetic axis near 260 K. ***D. M. Finlayson and T. Smith.*** *Philosophical Magazine*, v. 4, ser. 8, Oct. 1959, p. 1160-1163.

6778* The Fall-Out of Meteoric Iron Particles. A survey to determine the daily amounts of the fall-out of Fe particles of meteoric origin; to study the seasonal variations of the fall-out; and to compare the curve representing these seasonal variations of the fall-out with the one representing the seasonal variations in meteoric activity. ***E. A. Kreiken.*** *Planetary and Space Science*, v. 2, no. 1, Oct. 1959, p. 39-48.

6779 Space Investigation in the USSR—Past, Present, and Future. ***F. J. Krieger.*** *Rand Corporation, Report P-1702*, May 15, 1959, 9 pp. (T13 R15r Contin.)

6780 Review of I.G.Y. Upper Air Results. This review is to partially document the work done in many different places and to seek new insight into the ever-changing patterns in the atmosphere. ***William W. Kellogg.*** *Rand Corporation, Report P-1717-NSF*, June 5, 1959, 21 pp. (T13 R15r Contin.)

6781 Geomagnetic Control of Auroral Phenomena. Summarizes recent work, using later data for 1955, and broadens the scale of coverage. ***E. H. Vestine.*** *Rand Corporation, Report P-1753-NSF*, July 20, 1959, 12 pp. (T13 R15r Contin.)

6782 Cosmic-Ray-Produced Silicon-32 in Nature. Silicon-32, discovered in marine sponges, shows promise as a means for dating oceanographic phenomena. ***Devendra Lal, Edward D. Goldberg, and Minoru Koide.*** *Science*, v. 131, Feb. 5, 1960, p. 332-337.

6783 Global Fallout and Its Variability. Barium-140/-Strontium-90 ratio data for individual rains are discussed to show means of distinguishing between the stratospheric or tropospheric origin of fallout. ***E. A. Martell.*** *U. S. Air Force, Cambridge Research Center, Geophysical Research Papers No. 65*, Oct. 1959, 26 pp. (QC806 Un3.2g Vis.)

See also: **6395** (measurement of paleotemperatures); **6415** (xonotlite ($CaSiO_3$-H_2O) system).

GRAPHIC ARTS

6784* Smooth Transition Techniques in 16 mm. Film Editing. Some methods of obtaining smooth transitions easily are described, either by producing them in the camera while shooting, (fades in and out), or on the editing table by the use of black tape or perforated mylar and a special splicer that can easily be constructed. ***Herbert A. Fischler.*** *Biological Photographic Association*, v. 27, no. 3, Aug. 1959, p. 113-118.

6785* Intermittent-Action Camera Photographs Randomly Occurring Events. A recording system simultaneously photographs randomly occurring events displayed on an oscilloscope screen and the precise time of each event. *Design News*, v. 15, Feb. 29, 1960, p. 5.

6786* Pulse Operation of Lamps for Cinematograph Projection. As the light intensity of the picture rises, the sensitivity of the eye to flicker increases, so that an increase in brightness must be accompanied by stepping-up of the light/dark frequency. A method of achieving this aim is by using the new SPP 800 mercury-vapor projection lamp which, for a power consumption of 800 W, gives 3 light pulses of 3 msec. duration for each picture change, with a light output of 40,000 lm. A report is given on the characteristics of this lamp and on its manufacture and applications. *(In German.)* Impulsbetrieb bei Lampen für Kinoprojektion. ***Hans Jensen.*** *ETZ: Elektrotechnische Zeitschrift*, v. 12, Ausgabe B, no. 3, Feb. 1960, p. 49-53.

6787 Systems Analysis of the Photographic Process. I. A Three-Stage Model. A nonlinear, isotropic model is proposed to account for the micro-imaging behavior of the photographic process, without violating well-known properties of its large-area tone scale. Image growth and other "adjacency" effects are predicted. Each stage of the model is described in detail, and methods of determining the output image for any given input image are discussed. ***D. H. Kelly.*** *Optical Society of America, Journal*, v. 50, Mar. 1960, p. 269-276.

6788* Duplicate Platemaking. As with original printing surfaces, duplicate plates possess important and unique characteristics for letterpress printing production. Each kind of plate has its advantages, its natural market, its fringe applications. Within the next few years, duplicate plates will face their most serious competitive challenge from original plates. The new one-bite and high-speed etching processes bring photoengravings into the competitive area. ***J. Homer Winkler.*** *Photoengravers Bulletin*, v. 49, no. 8, Mar. 1960, p. 7-16.

6789* Progress in 8 mm Picture and Sound Reproduction. Several systems are being applied in order to add sound to narrow gage films. They differ by the type of sound recording material and by the corresponding transport system. The dual-tape system incorporating a commercial tape recorder for sound recording has proved its methods in practice. In the case of narrow gage film synchronization, the sound track is on the 8 mm film. Substantial difficulties as regards speed can be considered as overcome. *(In German.)* Fortschritte in der 8-mm-Bild- und Tonwiedergabe. ***Heinz Thiele.*** *Photo-Technik und Wirtschaft*, v. 11, Feb. 1960, p. 34 + 3 pages.

6790* Slide Projectors — Daily Problem of the Photo Trade. It may be expected that the uniform magazine will, in future, appear on the market. Since centering the frame carrier inside of the mounted transparency has not been generally solved, distant controlled focusing is still of practical importance, but requires skill. Questions relating to the type of lamp and to the cooling problem are carefully observed by projector manufacturers. *(In German.)* Dia-Projektoren—Tagesproblem des Photohandels. ***William Volkholz.*** *Photo-Technik und-Wirtschaft*, v. 11, Feb. 1960, p. 40-42.

6791* Ultrasonic Method of Plate Cleaning. Printing plates encrusted with dried ink are "blasted" clean in less than one minute by immersing them in a bath of water and detergent. *Printing Magazine*, v. 84, no. 2, Feb. 1960, p. 94-95.

6792* Packless Stereo Mats. Problems of advance in offing, of precise operation, of packless mat benefits and shrinkages, of form element heights, of composing room primer, and of molding pressure technique are discussed. ***MacD. Sinclair.*** *Printing Production*, v. 90, no. 4, Jan. 1960, p. 33 + 7 pages.

6793* Scientific Approach to the Mysteries of Color. Requirements of light sources, measurement of color, colorimeter inaccuracies, how to specify color, and visual tolerance limits are discussed. ***Warren L. Rhodes.*** *Printing Production*, v. 90, no. 4, Jan. 1960, p. 51 + 2 pages.

6794 Lunar Exploration by Photography From a Space Vehicle. Describes a camera which, as the payload of an early space vehicle, could photograph the moon. The resulting pictures would be superior to those obtained either by telescope or by television camera, such as those carried by Pioneers I and III. The film would be returned to earth in a recoverable capsule. ***Merton E. Davies.*** *Rand Corporation, Report P-1671*, Mar. 5, 1959, 22 pp. (T13 R15r Contin.)

6795 More Recent Developments in Photography Especially in Respect to the Reproduction Technique. The light-reactive substances, more important technically, were surveyed and a more detailed study was made of high-speed films, the "anti-Newton preparation in graphic films and the rapid processing of halide silver layers. *(In German.)* Neuere Entwicklungen der Photographie unter besonderer Berücksichtigung der Reproduktionstechnik. ***H. Zwicky.*** *Schweizer Archiv für angewandte Wissenschaft und Technik*, v. 25, Nov. 1959, p. 409-414.

6796 The Technical Motion Picture as a Means of Communication. Development of new techniques for the production of low-budget, fast-process motion pictures has made the use of film of practical importance to business firms for interdepartmental communiques, presentation of reports and other purposes. ***Marge T. Brislin.*** *Society of Motion Picture and Television Engineers, Journal*, v. 69, Jan. 1960, p. 45-46.

6797 An Improved *f*/10 Sweeping-Image Camera. A rotating-mirror sweeping-image camera with mirror distortion corrector, faster writing speed, and apochromatic relay lens has resolving power greater than that of earlier models. An adjustable cylinder lens corrects astigmatism from mirror surface distortion. ***Berlyn Brixner.*** *Society of Motion Picture and Television Engineers, Journal*, v. 69, Feb. 1960, p. 109-112.

6798 Formation of Silver Sulfide in the Photographic Image During Fixation. The amount of sulfiding of the Ag in the image during fixation of film and paper was determined. The amount of the Ag reacting depends on the type of the light-sensitive layer. A small amount of K iodide added to the fixing bath was found effective in preventing most of the sulfiding of the Ag image during fixation. ***Chester I. Pope.*** *U. S. National Bureau of Standards, Journal of Research, Section C, Engineering and Instrumentation*, v. 64, no. 1, Jan.-Mar. 1960, p. 65-73.

See also: **6512** (flexographic printing); **7264** (photosensitive polymers).

HEAT POWER

6799* An Elementary Design Discussion of Thermoelectric Generation. The problems confronting the development and design of thermoelectric generators which extract maximum usefulness from today's semimetal thermoelectric materials were presented. ***E. W. Bollmeier.*** *Applications and Industry*, 1960, no. 46, Jan., p. 445-450.

6800 Fuel Cells for Space Vehicles. Closed-cycle, regenerative fuel cell shows potential as a long-running, high-efficiency power source for space applications. ***M. G. Del Duca, J. M. Fuscoe, and T. A. Johnston.*** *Astronautics*, v. 5, Mar. 1960, p. 36 + 5 pages.

6801* Protecting Boiler Feed Pumps Against Flashing. ***P. H. Hardie, Igor J. Karassik, and L. E. Zabel.*** *Combustion*, v. 31, no. 8, Feb. 1960, p. 37-40.

6802 The Diesel Engine—Its Theory, Basic Design, and Economics. General problems, combustion, dynamics, statics, parasitics and economics are discussed. ***L. V. Armstrong and J. B. Hartman.*** 360 pp. 1959. The MacMillan Co., New York. (TJ795 Ar57d)

6803* Remote Control Gas Turbine Power Station Goes Into Service. *Gas and Oil Power*, v. 55, no. 660, Jan. 1960, p. 5-7.

6804 Heat Transfer—Chicago. Contains 26 different scientific papers. ***Alan S. Foust, editor.*** 216 pp. 1959. American Institute of Chemical Engineers, New York. (QC320 Am35he)

6805 The 2000 Hour Proteus Turboprop. Lessons learned on the Proteus as Bristol engineers developed it from an overhaul life of 500 hr to the present 2000 hr. ***P. F. Green.*** *Mechanical Engineering*, v. 82, Jan. 1960, p. 37-40.

6806* Soviet Missiles. II. Solid Rockets. Describes some of the Soviet missiles with regard to size, types, operation, and type of propellants used. ***Alfred J. Zaehringer.*** *Missile Design & Development*, v. 7, Feb. 1960, p. 26-28.

6807* Production Testing of Turbochargers. Each turbocharger is subjected to a standard production test. Because of the simple construction of the Holset turbocharger, servicing is straight-forward. Turbocharger applications are deemed the responsibility of engine makers rather than individual operators. *Oil Engine and Gas Turbine*, v. 27, Feb. 1960, p. 280-281.

6808* Turbocharging Practice and Prospects. If the characteristics of the turbocharger and diesel engine are accurately matched, turbocharging offers more economical operation and gives automatic compensation of altitude effects. ***P. A. C. Brockington.*** *Overseas Engineer*, v. 33, Feb. 1960, p. 158-159.

6809* Conversion of Heat Into Work. Some Thermodynamic Aspects. I. ***A. V. Brancker.*** *Petroleum*, v. 23, Feb. 1960, p. 56-59.

6810* Conversion of Heat Into Work. Some Thermodynamic Aspects. II. Studies the thermodynamic aspects of the so-called direct conversion of heat into electrical energy. Although efficiencies of as high as 70% have been claimed for direct conversion processes using fuel cells, there are still several causes of inefficiency. ***A. V. Brancker.*** *Petroleum*, v. 23, Mar. 1960, p. 105 + 4 pages.

6811 How to Make Solar Cells. Details of the materials and operation of the battery. ***D. M. Chapin.*** *Radio-Electronics*, v. 31, Mar. 1960, p. 89 + 3 pages.

6812* Rosen Reports on European Engine Research. Covers military multifuel automotive-type equipment. ***C. G. A. Rosen.*** *SAE Journal*, v. 68, Feb. 1960, p. 60-63.

6813* The Back-Pressure Steam Turbine and Its Industrial Importance. ***W. Eigenmann.*** *Sulzer Technical Review*, v. 41, no. 1, 1959, p. 47-54.

See also: **6724** (hydrogen for power).

INFORMATION—PREPARATION AND DISSEMINATION

6814 The Truth About Industrial Spying. Up-to-date intelligence is a vital raw material for management decisions in the chemical process industries. Some companies use unusual methods to satisfy this need. ***Roland A. Labine.*** *Chemical Engineering*, v. 67, Feb. 22, 1960, p. 121-126.

6815 Closing the Loop on Literature Automation. Scans the field of machine documentation and reports on current activities by companies and research organizations. *Chemical Week*, v. 86, no. 8, Feb. 20, 1960, p. 75 + 4 pages.

6816 Introduction to Semantics and Formalization of Logic. Purpose is to furnish a theory of semantics and its relation to syntactical concepts. This volume combines two volumes published earlier called *Studies in Semantics*. ***Rudolf Carnap.*** 159 pp. 1959. Harvard University Press, Cambridge, Mass. (P325 C21i)

6817* Information Retrieval: A View From the Reference Desk. Any attempts to improve information retrieval must take into account the human inquirer and interpreter, with all their actual possibilities and limitations, as well as the more readily manipulated elements of the information to be kept available and the retrieval systems for providing this access. ***Mary Francillon.*** *Journal of Documentation*, v. 15, no. 4, Dec. 1959, p. 187-198.

6818* The Readability of Type. The choice of legible type is of great importance, especially for children. This article discusses the principles involved. ***Cyril Burt.*** *New Scientist*, v. 7, Feb. 4, 1960, p. 277-279.

6819* User Effects of Astia Automation. New program marks the beginning of automation of a bibliographic and service function the size and scope of ASTIA. ***J. Heston Heald.*** *Sci-Tech News*, v. 14, no. 1, Spring, 1960, p. 6 + 2 pages.

6820 Organic Fluorine Compounds Prepared by the Electrochemical Method. Literature Survey, 1950-July 1959. A list of books, journals, patents, and reports giving information on the subject. ***Sarah Ann Shahan.*** *U. S. Atomic Energy Commission*, K-1438, Jan. 15, 1960, 20 pp. (UF767 Un3.lk Contin.)

See also: **6257** (dictionary of medical discoveries).

INSTRUMENTATION

6821* A Timing-Pulse Generator. The equipment described generates timing pulses for general laboratory use. The pulses serve as time signals which do not differ from Universal Time (UT 2) by more than ± 0.05 millisec. ***C. S. Fowler.*** *British Institution of Radio Engineers, Journal*, v. 20, Feb. 1960, p. 125-126.

6822* Transistors in Industrial Instrumentation. The application of transistors to instrumentation has resulted in the production of compact, highly reliable units. All the instruments here described are energized from the conventional supply. There is no reason why they should not be designed to work from a low voltage supply or even batteries. ***D. R. Holloway.*** *Instrument Practice*, v. 14, Feb. 1960, p. 151-155.

6823* A Near-Infrared Process Analyzer for Liquid Samples. While most industrial IR analyzers can be used on gaseous samples only, this unique new instrument analyzes liquids directly: it needs no vaporizer with its attendant sampling problems. Water sensitivities of 1 to 10 ppm are possible in aromatics, alcohols, ketones and many other organics widely used in chemical and petroleum processes. ***G. J. Hecht, J. A. Edinborgh, and V. N. Smith.*** *ISA Journal*, v. 7, Feb. 1960, p. 40-44.

6824* Analyzing the Instrument Market. Increasing complexity and rapid expansion of instrument technology demand urgent attention by both makers and users to collect and analyze manufacturing and marketing data. *ISA Journal*, v. 7, Feb. 1960, p. 62-66.

6825 Two Thermocouples Suitable for Measurement of Temperatures Up to 2800°C. The thermoelectric characteristics of two high-temperature thermocouples of W/26% Re-W and Ta/26% Re-W are described, and a method of determining the emf of the couples up to a temperature of 2800 C is given. ***D. A. Davies.*** *Journal of Scientific Instruments*, v. 37, Jan. 1960, p. 15-17.

6826 Design of Laboratory Furnaces. Illustrates the use of a heat balance in the design of small furnaces, and then discusses the principles of arc, arc-image, induction, electron-bombardment, resistor-heated and gas-fired furnaces. Constructional details are mentioned briefly with each type of furnace considered. A comprehensive table of resistor elements, refractory tubes, and insulating materials and their properties is included. Methods of controlling small furnaces are discussed. ***P. L. Start and M. W. Thring.*** *Journal of Scientific Instruments*, v. 37, Jan. 1960, p. 17-24.

6827 X-ray Diffraction by Single Crystals at Low Temperatures: A Cryostat for Use With Liquid Hydrogen. Techniques for cooling a single crystal in X-ray work are discussed, and the merits of the continuous gas-stream method are noted. It is shown that H gas has properties which render it especially suitable for use in this way. A simple modification of the usual method for generating the cold gas stream is described. The apparatus is capable of maintaining a crystal at a temperature of about 23 K (using H) for periods up to 48 hr., without interference with the operation of standard diffraction techniques. ***J. H. Robertson.*** *Journal of Scientific Instruments*, v. 37, Feb. 1960, p. 41-45.

6828 Simple Device for Use With Platform Weighbridges in the Accurate Determination of Burning Rates. Device comprises an automatically adjusted "chain rider" which permits measurement of small weight changes to better than ±⅝oz with a normal 5 cwt platform weighbridge. ***J. E. Roughton.*** *Journal of Scientific Instruments*, v. 37, Feb. 1960, p. 45-46.

6829 Some Techniques for Recording and Measuring Time-Resolved Spectra. An apparatus is described employing a rotating mirror time-resolving device before the slit of a quartz photographic spectrograph. Writing speeds of up to 5·1 mm/μs are obtained. Consideration of possible calibration techniques involves some preliminary results on reciprocity law failure at very short exposure times. A pulsed calibration source is described in which a continuum at 26,000 K is maintained for 15 μs, and this is used to provide an absolute calibration of the records. ***A. H. Gabriel.*** *Journal of Scientific Instruments*, v. 37, Feb. 1960, p. 50-53.

6830 An Electromicrobalance for Weighing Fibres. An electromicrobalance is described that has a capacity of about 1·5 mg and weighs up to about 1 μg. ***F. R. Morgan.*** *Journal of Scientific Instruments*, v. 37, Feb. 1960, p. 53-54.

6831 Recording Calorimeter for the Measurement of Heats of Wetting, Mixing, or Solution. A calorimeter has been designed for the measurement of heat liberations of less than 50 cal. Automatic temperature recording with variable amplification has been linked to the measuring thermocouples to produce a permanent record of temperature changes in the calorimeter. Magnetically operated stirring and reaction initiation (by bursting an evacuated bulb containing adsorbent or reagent) are employed. ***F. A. P. Maggs and P. H. Schwabe.*** *Journal of Scientific Instruments*, v. 37, Feb. 1960, p. 60-64.

6832 Large Proportional Counter Spectrometer for the Study of Radioactive Samples With Low Specific Activity. The design and construction of a cylindrical proportional counter 36 in. long, 12 in. inside diameter is described, and its performance as a spectrometer for studying soft radiations from radioactive samples of low specific activity is given. The counter tank is operated in an axial magnetic field of 2500 gauss to constrain beta rays to helical paths. ***J. T. Holloway, D. C. Lu, and D. J. Zaffarano.*** *Review of Scientific Instruments*, v. 31, Feb. 1960, p. 91-95.

6833 Precision Zeeman Modulation Microwave Spectrometer. A high-precision Zeeman modulated microwave spectrometer was developed to measure the rotational fine structure of O. The transitions lie between 50 and 65 kMc. Direct measurement of the line widths was made at pressures from 20 to 500 μ. Twelve lines were measured to better than 0.01 Mc and 11-line breadth parameters were measured to 0.1 Mc/mm. ***Robert W. Zimmerer.*** *Review of Scientific Instruments*, v. 31, Feb. 1960, p. 106-111.

6834 Apparatus for Direct Observation of Low-Energy Electron Diffraction Patterns. The diffracted electrons pass through a pair of grids and then are accelerated by a potential difference of the order of 10^3v to excite the fluorescent screen. The equipment is designed for high vacuum, and pressures below 2×10^{-10} mm Hg have been maintained. ***E. J. Scheibner, L. H. Germer, and C. D. Hartman.*** *Review of Scientific Instruments*, v. 31, Feb. 1960, p. 112-114.

6835 Ultra-High-Pressure, High-Temperature Apparatus: the "Belt". Equipment is described for maintaining pressures of 100,000 atmos at temperatures in excess of 2000 C for long periods of time. The equipment makes use of conical Carboloy pistons that push into each end of a specially shaped Carboloy chamber. Both chamber and pistons receive lateral support from stressed binding rings. ***H. Tracy Hall.*** *Review of Scientific Instruments*, v. 31, Feb. 1960, p. 125-131.

6836 Techniques of Cathode Temperature Measurements as Applied to Commercial Cathode-Ray Tubes. Thermocouple, optical pyrometer, and retarding potential techniques for the measurement of cathode temperatures in commercial cathode-ray tubes have been investigated to determine their relative merits, limitations, and corrections. The thermocouple method is accurate and reliable provided necessary lead loss corrections are made. ***P. P. Coppola.*** *Review of Scientific Instruments*, v. 31, Feb. 1960, p. 137-143.

6837 Magnetically Driven Fast-Acting Valve for Gas Injection Into High Vacua. A description is given of a valve suitable for use in studies involving the acceleration of plasmas into regions of high vacua. Valve opening durations of less than 60 μsec may be attained, and amounts of gas lower than 0.01 cc STP may be introduced. Valve performance characteristics and measuring techniques are discussed. ***B. Gorowitz, K. Moses, and P. Gloersen.*** *Review of Scientific Instruments,* v. 31, Feb. 1960, p. 146-148.

6838 Digitron—A Digital Time Analyzer for Microsecond Intervals. A system is described which measures microsecond time intervals by counting pulses from a 10-Mc ringing circuit. The data are accumulated in a magnetic core memory. The measured standard deviation of channel widths is ≤0.15%, and the drift in absolute time calibration is <0.1% for periods of several days. ***R. A. Swanson.*** *Review of Scientific Instruments,* v. 31, Feb. 1960, p. 149-154.

6839 Thin-Heater Thermal Conductivity Apparatus. Apparatus is described for measuring the thermal conductivity of insulating materials. A constant current is passed through a rectangular sheet of stainless steel foil in such a manner that the rate of generation of heat per unit area can be computed from electrical measurements. Identical sample slabs are placed against opposite sides of the heater, and the combination is enclosed in a plastic film and immersed in a bath having constant and uniform temperature. The temperature drops across the central portions of the sample slabs are measured with differential thermocouples. ***Nathanel E. Hager, Jr.*** *Review of Scientific Instruments,* v. 31, Feb. 1960, p. 177-185.

6840* A Non-Isothermal Electrical Calorimeter for the Measurement of Reaction and Solution Heats. The calorimeter can be adapted for use in an inert atmosphere, as is necessary in the case of solutions of oxidizable ions. *(In Italian.)* Un calorimetro elettrico non isotermo per la misura dei calori di reazione e di soluzione. ***Luigi Sacconi, Piero Paoletti, and Mario Ciampolini.*** *Ricerca Scientifica,* v. 29, Nov. 1959, p. 2412-2419.

6841 A Continuous Boiling Point Analyzer and Its Application to the Hydrogen Fluoride-Water System. A simple and inexpensive instrument is described which provides a continuously recorded analysis of binary liquid or vapor mixtures by measurement of the boiling point. ***W. S. Pappas.*** *U. S. Atomic Energy Commission,* K-1354, Feb. 10, 1960, 15 pp. (UF767 Un3.1k Contin.)

LUBRICATION AND FRICTION

6842* Retention of Liquids in Soap/Hydrocarbon Systems. A description is given of the measurement of vapor pressures of the liquid phase in soap-hydrocarbon systems. A novel method using the electric discharge detector is employed for these measurements. The results are used to construct desorption isotherms for the systems. ***A. J. Groszek and G. H. Bell.*** *NLGI Spokesman,* v. 23, no. 12, Mar. 1960, p. 467-474.

6843 Jet and Space Age Lubrication. Functions of aircraft lubricants; supersonic lubrication problems; present range of aircraft fluids; radiation resistant lubricants; solid film lubricants; vapor lubricated bearings; possibilities of ceramics. ***E. B. Palmer.*** *Scientific Lubrication,* v. 12, Feb. 1960, p. 12 + 4 pages.

See also: **7317** (rolling friction of elastomers).

MECHANICAL ENGINEERING

6844 Solid Cone in Longitudinal Half-Wave Resonance. Presents design equations for ultrasonic vibrations in conical sections. Formulas are derived for determining particle velocity, particle velocity amplification, stresses, length, and mechanical impedance of sections of solid cones—lateral dimensions small compared with the wavelength—in longitudinal half-wave resonance. Unlike the velocity amplification factor of the exponentially tapered bar, that of the conical section does not approach infinity but approaches a limit as the ratio of end diameters approaches infinity. ***Dale Ensminger.*** *Acoustical Society of America, Journal,* v. 32, Feb. 1960, p. 194-196.

6845 Potential of the Air-Cushion Vehicle. Estimates of gross power requirements are summarized and extended to include estimates of the payload-range capability. These data are then utilized to illustrate the "working rate" capability of "off-the-road" air-cushion vehicles compared with more conventional transportation media. ***Roy P. Jackson and Murray F. Southcote.*** *Aero/Space Engineering,* v. 19, Mar. 1960, p. 40-47.

6846* Yield Moments of Reinforced Concrete Beams and Columns. A numerical method is developed for finding the moment at which the tensile reinforcement in a reinforced concrete beam will just reach the yield point if the beam is under-reinforced, or at which the concrete will reach its ultimate strain if the beam is over-reinforced. ***Clarence W. Dunham and Hans Gesund.*** *American Concrete Institute, Journal,* v. 31; *ACI Proceedings,* v. 56, no. 9, Mar. 1960, p. 837-851.

6847 Applied Mechanics. Dynamics. General principles of dynamics of particles, vibrating systems, rigid bodies, and nonrigid systems of particles; advanced methods. ***George W. Housner and Donald E. Hudson.*** 2nd Ed. 392 pp. 1959. D. Van Nostrand Co., New York. (TA350 H81a2)

6848 Nomographic Synthesis of Generator Linkages. Presents a graphical technique for optimizing generator-linkage design by systematic scanning of five linkage parameters. A nomograph of linkage behavior, simplified through symmetry of quadrilateral relationships, fixes the optimum linkage as a rectilinear, horizontal plot from which a measure of the error is available. ***Douglas P. Adams.*** *ASME, Transactions, Series B, Journal of Engineering for Industry,* v. 82, no. 1, Feb. 1960, p. 29-40.

6849 The Effect of Presetting Helical Compression Springs. A procedure for predicting the increase in fatigue load carrying capacity due to presetting helical springs is developed, based on the actual stress-strain curve of a material. Reasonable correlation with experimental results is obtained. For the cyclic load conditions and the material chosen, an increase in load carrying capacity of 21% was observed. It is expected that an increase of approximately 40% could be realized with slight modification of fabrication techniques. ***T. J. Atterbury and W. B. Dibolly, Jr.*** *ASME, Transactions, Series B, Journal of Engineering for Industry,* v. 82, no. 1, Feb. 1960, p. 41-46.

6850 A Quantitative Investigation of the Factors Which Influence the Fatigue Life of a V-Belt. A new design method for V-belts was developed. The new method involves a horsepower-life relationship which was derived on the basis of the results of an experimental program of belt testing involving many hundreds of tests, together with an analysis of these data which introduces several new concepts of stress analysis for rubber-textile structures. ***S. M. Marco, W. L. Starkey, and K. G. Hornung.*** *ASME, Transactions, Series B, Journal of Engineering for Industry,* v. 82, no. 1, Feb. 1960, p. 47-59.

6851 Edge Influence Coefficients for Toroidal Shells of Positive Gaussian Curvature. Tables are given for the edge deformations of constant-thickness toroidal shells subject to uniform pressure and edge bending loads. Over one hundred different shell geometries were investigated and the results are presented in dimensionless form. Possession of these cofficients, which were obtained on a digital computer, means that a rapid and accurate formulation of the compatibility equations at toroidal shell junctions is now possible. ***G. D. Galletly.*** *ASME, Transactions, Series B, Journal of Engineering for Industry,* v. 82, no. 1, Feb. 1960, p. 60-68.

6852 Edge Influence Coefficients for Toroidal Shells of Negative Gaussian Curvature. Gives tables for the edge deformations of constant-thickness toroidal shells subject to edge bending loads and uniform pressure. ***G. D. Galletly.*** *ASME, Transactions, Series B, Journal of Engineering for Industry,* v. 82, no. 1, Feb. 1960, p. 69-75.

6853* Suspension of Internal-Combustion Engines in Vehicles. Following a description of some forms of mounting unit, deals with incidental vibrations which are often caused by the flexibility of the vehicle structure. The elimination of these vibrations has been a major problem in recent years. Besides some orthodox designs described in detail, reference is made to a three-cylinder in-line, a three-cylinder opposed-piston engine mounting arrangement, and the steel spring mountings used by an Italian car manufacturer. ***M. Horovitz.*** *Institution of Mechanical Engineers, Automobile Division, Proceedings,* 1957-1958, no. 1, p. 17-51.

6854 Kinematics. Equations of plane motion; cams; centros and velocities; relative accelerations; spur gears; helical, bevel, and worm gearing; flexible connectors and friction wheels; synthesis of mechanisms; miscellaneous devices. ***Virgil Moring Faires.*** 468 pp. 1959. McGraw-Hill, New York. (TJ175 F16k)

6855 8 Machinery Frames for Absorbing Twist Loads. Equations compare rigidity of frames in terms of loads and deflections. ***N. E. Houtz and M. F. Spotts.*** *Product Engineering,* v. 31, no. 8, Feb. 22, 1960, p. 45-48.

6556 When Design Calls for a Choice: Vibrators — 4 Types. Characteristics of electric, hydraulic, air, and mechanical vibrators. ***Frederick Marich.*** *Product Engineering* (Design Digest Issue), v. 31, no. 10, Mar. 7, 1960, p. 40-43.

6857 From Thermodynamics, Equation for Adiabatic Head Selects Compressor Type. If one knows the pressure ratio, required flow, and shaft speed, the "adiabatic head" concept can lead directly to the choice between a positive-displacement and centrifugal compressor—for all gases. Describes a step-by-step method, including the needed reference data. ***Wilbur A. Spraker and Robert A. Stein.*** *Product Engineering* (Design Digest Issue), v. 31, no. 10, Mar. 7, 1960, p. 47-51.

6858* Developing Cam System Charts for Optimum Performance. Well-balanced cam systems are essential to the proper performance of four-slide screw machines and most automatic machinery. Optimum cam systems can be designed using the graphical method described. ***Werner Vogt.*** *Tool Engineer,* v. 44, no. 3, Mar. 1960, p. 115-124.

6859 Maximum Volume-to-Stress Ratio for a Two-Radii-Contour Diaphragm Pump. Recent experimental work with diaphragm pumps employing the two-radii type of contoured heads indicates that an optimum ratio of the two radii exists which provides a maximum ratio of displacement volume to stress. The purpose of this study was to determine by analytical methods whether an optimum design does exist and, if so, what it is. In order to do this, it was necessary to establish a reasonable criterion for failure. The proposed criterion considers the effect of biaxial stresses on fatigue failure through the use of the Mises-Hencky criterion for fatigue failure. ***R. D. Cheverton.*** *U. S. Atomic Energy Commission, ORNL-2814,* Feb. 15, 1960, 18 pp. (UF767 U3o Contin.)

6860 Vibration Engineering. A practical treatise on the balancing of engines, mechanical vibration, and vibration isolation. ***W. Ker Wilson.*** 292 pp. 1959. Charles Griffin & Co., London. (TJ153 W69v)

See also: **6919** (design of Mg castings).

METALLURGY

6861 A Hypereutectic Aluminum-Silicon Alloy. Because of their low coefficient of thermal expansion, high hardness and excellent wear resistance, their potential was recognized early in their development. One of the commercial hypereutectic Al-Si alloys is analyzed, giving its structure and various properties, as well as foundry characteristics. ***Rolf Kissling and Oldrich Tichy.*** *American Foundrymen's Society, Transactions,* v. 67, 1959, p. 347-352. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6862* Nuclear Magnetic Resonance in Physical Metallurgy. The elementary principles of nuclear magnetic resonance are described. The various factors which influence this phenomenon are outlined, and it is shown how these can be associated with dislocations, impurities, order-disorder transformations, polygonization, self-diffusion, precipitation, and the electronic structure of metals and alloys. ***G. W. West.*** *Australian Institute of Metals, Journal,* v. 4, no. 3, Nov. 1959, p. 156-163.

6863 British and Foreign Specifications for Steel Castings. Summaries, comparisons, relevant information for U.S.A., Great Britain, selected European countries (exclusive of the USSR and satellites), as available June 30, 1959. 48 pp. 1959. The British Steel Castings Research Association, Sheffield, Great Britain. (TA472 B77.7b)

6864 Qualification of Inconel for Nuclear Power Plant Applications. In order to qualify Inconel for service in the stream generation system of pressurized water nuclear power plants, the behavior of this material was investigated with respect to resistance to corrosion, radioactivity of corrosion products, and fabrication; corrosion data is given. Corrosion tests were conducted in simulated primary and secondary reactor waters on Inconel specimens in several conditions of heat treatment and composition. Stressed specimens, weldments, galvanic couples, and crevice specimens were included. Under all conditions a tightly adherent film formed on the specimens and the corrosion rates were comparable to those of austenitic stainless steels. The Inconel alloy does not suffer intergranular attack or stress corrosion cracking in reactor waters. ***H. R. Copson and W. E. Berry.*** *Corrosion,* v. 16, Feb. 1960, p. 123-129.

6865 The Preparation and Properties of Aluminum Antimonide. An improved method of growing single crystals of aluminum antimonide is described. Oxide from the Al has been eliminated by a vacuum heat-treating technique which also removes volatile impurities. The mobility of the positive carriers in AlSb at 300 K is found to be greater than 400 cm^2/v-sec. Values as high as 5000 cm^2/v-sec have been measured at 50 K. The p-type impurities have an activation energy of about 0.02 ev in AlSb. A maximum is observed at 4000 gauss in the magnetic-field dependence of the Hall coefficient at 77 K. ***W. P. Allred, W. L. Mefferd, and R. K. Willardson.*** *Electrochemical Society, Journal,* v. 107, Feb. 1960, p. 117-122.

6866 The Development and Evaluation of a High-Temperature Titanium Alloy. Studies were made on Hylite 50 (Al-4; Mo-4; Sn-2; Si-0.5). The optimum combination of tensile and creep properties was achieved by air-cooling the alloy from 900 C and aging for 24 hr at 500 C. A study of forging and rolling temperatures and reductions indicated that when the alloy was given this heat-treatment, its properties were substantially independent of fabrication history. In contrast, if the alloy was subjected to stress-relief at 650 C, the creep and mechanical properties varied widely with different fabrication methods. ***G. T. Harris, H. C. Child, and A. L. Dalton.*** *Institute of Metals, Journal,* v. 88, pt. 3, Nov. 1959, p. 112-120.

6867 The Constitution of Tin-Thallium Alloys. A revised constitutional diagram was constructed from the results of thermal analysis and X-ray and metallographic examination. Tin depresses the allotropic change point in Tl so that with ~7% Sn present, the δ form is stable at room temperature. The similarity between the Sn-Pb and Sn-Tl diagrams suggests that Pb and Tl behave in a similar way when alloyed with Sn. ***J. C. Blade and E. C. Ellwood.*** *Institute of Metals, Journal,* v. 88, pt. 4, Dec. 1959, p. 186-189.

6868 How Technology Widens Scope of Minor Metals. High cost of many minor metals has prevented their general use in metalworking. But technical breakthroughs and space age demands create new markets. ***F. J. Starin.*** *Iron Age,* v. 185, no. 7, Feb. 18, 1960, p. 67-69.

6869 Airframes, Titanium. The rapidly accelerating technology of competitive weapon systems, combined with strategic tactical consideration, may well result in almost complete abandonment of some concepts. Strictly tactical airplanes and logistic or transport vehicles still appear to be desirable. If these operate at high temperatures, (say up to 800 F) Ti will certainly be quite strongly considered as the major construc-

tional material. ***E. A. Simkovich.*** *Journal of Metals,* v. 12, Feb. 1960, p. 128-129.

6870 Steel in Airframes. It is indicated that Mach three aircraft will use steel as the basic structural material except in certain specific areas where Ti shows a high competitive advantage. ***E. A. Green.*** *Journal of Metals,* v. 12, Feb. 1960, p. 129-131.

6871 Rimmed Steel Magnetic Sheets . . . How They Were Produced for the Proton Synchrotron. An outline of the manufacturing procedure and magnetic properties of steel sheet being used for the construction of magnetic blocks in the 25-bev proton synchrotron of the European Organization for Nuclear Research . . . CERN . . . at Geneva, Switzerland. ***G. Odone and B. Sommacal.*** *Journal of Metals,* v. 12, Feb. 1960, p. 156-157.

6872 High Temperature Materials. As the required temperatures for rocket and missile applications increase, it is obvious that refractory metals such as Mo, Cb, and W will become important. Together with this we are finding more exacting requirements placed on the older more familiar Ni- and Co-base superalloys. ***R. W. Guard.*** *Journal of Metals,* v. 12, Feb. 1960, p. 158.

6873 Columbium in Ferritic Steels. ***W. C. Leslie.*** *Journal of Metals,* v. 12, Feb. 1960, p. 159.

6874* Loss of Metal From Chromium at Elevated Temperatures in Air. Relatively small variations in air flow at very low flow rates can have a considerable effect on the high-temperature behavior of metals. ***G. R. Wilms and T. W. Rea.*** *Journal of the Less-Common Metals,* v. 1, no. 5, Oct. 1959, p. 411-412.

6875 Copper and Copper Alloys. A Survey of Technical Progress During 1959. Discusses extraction, fabrication, finishing, properties and testing. ***E. Voce.*** *Metallurgia,* v. 60, Dec. 1959, p. 247-252.

6876 Low Pressure Metallurgy. A General Survey. The carrying out of metallurgical operations in vacuum requires more than the prevention of oxidation. Pressure variations add a further dimension to the degrees of freedom previously represented only by temperature and concentration, with the result that equilibrium conditions can frequently be displaced in a favorable direction. ***A. S. Darling.*** *Metallurgia,* v. 60, Dec. 1959, p. 263-267.

6877* Magnesium Grating. High strength/weight ratio, plus good resistance to alkalis, make Mg the ideal material for many industrial grating applications. ***Milton Van Dyke.*** *Modern Metals,* v. 16, no. 1, Feb. 1960, p. 43 + 2 pages.

6878 Metallurgical Studies of Niobium-Uranium Alloys. In a continuing program, fabrication characteristics, physical and mechanical properties, and corrosion behavior in air, CO_2, NaK, water, and steam were studied for binary Nb fuel alloys containing 10, 20, 30, 40, 50, and 60 w/o U. The impurity combinations employed were 600 ppm O and 0.74 w/o Zr, 700 ppm O and 0.17 w/o Zr, and 300 ppm O and 0.02 w/o Zr. Specimens of these alloys retained their hardness up to 900 C. The impurity combinations employed in the base Nb appeared to have no effect on the corrosion behavior and mechanical properties of the alloys. ***John A. DeMastry, Frederic R. Shober, and Ronald F. Dickerson.*** *U. S. Atomic Energy Commission, BMI-*1400, Dec. 7, 1959, 42 pp. (UF767 U3b Contin.)

6879 Using Steel Wisely. A dissertation on the principles underlying the selection of the correct steel for any engineering application. ***Leslie Aitchison and William I. Pumphrey.*** 241 pp. 1958. MacDonald & Evans, Ltd., London. (TA472 Ai9u)

METALS—CORROSION

6880 The Corrosion of Aluminium and Its Alloys in High-Pressure Steam. Three distinct types of corrosion were observed: (1) uniform film growth, (2) penetrating attack, starting from points and spreading over the whole surface, the final product being a fine grey powder, and (3) "growth" of the specimen. Up to 350 C, uniform corrosion was the rule, and instances of rapid failure were very few. At 325 C and constant pressure, the uniform corrosion followed a parabolic law. ***N. J. M. Wilkins and J. N. Wanklyn.*** *Institute of Metals, Journal,* v. 88, pt. 3, Nov. 1959, p. 134-140.

6881 Metals in Chemical and Marine Applications. While over-all performance may dictate Ti, more attention to design or to changes in operating conditions will often allow a less costly material to be substituted. It may, in some cases, be cheaper to change the environment than to use this expensive material. The competition from Ti has spurred interest in some older more established types of materials. For example, there are new alloys being developed in the Ni-base field and in the Cu-base field which will be of interest to those who have material problems for chemical or marine service. Titanium has many potential areas of usefulness, but much more large-scale plant experience is needed before use of Ti can be fully justified. Titanium, and its alloys in chemical and marine service, will continue to have competition from steel and its alloys, Al-base, Cu-base, Ni-base, and special alloys, depending on the situation. ***Frederick W. Fink.*** *Journal of Metals,* v. 12, Feb. 1960, p. 146-148.

6882 Effects of Molten Boron Oxide on High Temperature Materials. The corrosive ability of boron oxide, a combustion product of B-containing high-energy fuels, is reported. A sequence of 30 environmental exposures of high-temperature alloys and ceramic coatings typical of those available for use in aircraft power plants was completed. These exposures, which resulted in the destructive corrosion of the high temperature test materials, are discussed in this report. Results showed that Ni-base, Co-base, Fe-base, and Ni-Cr-Co-Fe alloys were corroded at temperatures less than 2163 F by combinations of intergranular corrosion, pitting, and general surface attack. The results indicated that the presence of Al as an alloy constituent or as a surface coating can cause catastrophic corrosion of that alloy at relatively low temperatures. The effects of other constituents are not as well defined; however, Mn is suspected of initiating the corrosive reaction in alloys not containing Al. ***Charles R. Andrews.*** *U. S. Air Force, Wright Air Development Center, WADC Technical Report* 58-443, Sept. 1959, 137 pp. (TL507 Un3.18w Vis.)

6883 Effect of Additions to Zircaloy on Hydrogen Pickup During Aqueous Corrosion. The Ni in Zircaloy-2 is believed to be the major constituent responsible for the relatively high H absorption. Additions of up to 0.5 w/o Sb, As, Bi, or Te were selected on the basis of their known ability to poison the catalytic effects of Ni in hydrogenation reactions of other systems. Results of tests conducted for a total of 224 days in 600 and 680 F water and 750 F steam revealed no decrease in H absorption in modified Zircaloy-2 containing the aforementioned alloy additions. Hydrogen absorption increased when these alloying elements were present in the range of 0.1 to 0.2 w/o. Corrosion resistance also decreased with alloy additions in these ranges. ***Warren E. Berry, Earl L. White, and Frederick W. Fink.*** *U. S. Atomic Energy Commission, BMI-*1402, Dec. 29, 1959, 31 pp. (UF767 U3b Contin.)

6884 Behavior of Rubbing Molybdenum Surfaces in Sodium Environments. Sodium was found to influence the sliding behavior of molybdenum by modifying reacted films which provided boundary lubrication. These effects were also found to be temperature dependent. It was established that a sodium molybdate film on the molybdenum surfaces can be associated with low friction and diminished surface damage. ***John W. Kissel, Carl W. Melton, and William A. Glaeser.*** *U. S. Atomic Energy Commission, BMI-*1405, Jan. 4, 1960, 23 pp. (UF767 U3b Contin.)

See also: **6520** (anti-corrosive water-emulsion paint).

METALS—EXTRACTION AND REFINING

6885* Kinetics of Iron Oxide Reduction. Iron-oxide pellets were reduced in H over a range of 0.07 to 0.97 atm pressure and 400 to 1050 C. The rate of reduction per unit area is found

to be constant with time and directly proportional to the partial pressure of H. The enthalpy of activation for the temperature range 400 to 550 C is 14,900 cal per mole and for the temperature range 600 to 1050 C is 15,300 cal per mole. ***W. M. McKeean.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 2-6.

6886* Graphical Technique for Multistaged Fluidized Bed Operations as Applied to Iron-Ore Reduction. A graphical method for determination of the performance of a staged countercurrent system wherein reactions such as the direct reduction of Fe ores occur. This is a modification of the McCabe-Thiele method used in distillation calculations. Some small-scale operating data of Fe reduction are presented, and methods for incorporating these data into the graphical calculations are included. ***H. P. Meissner and Frank C. Schora.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 12-21.

6887* The Rate and Mechanism of the Sulfurization of Carbon-Saturated Iron. The rate and mechanism of S transfer from slag to C-saturated Fe, i.e., sulfurization, was studied. It was shown that increasing concentrations of Si, Mn, Ti, and Al in the metal have a retarding effect upon the rate of transfer from 15% Al_2O_3, 45% CaO, 40% SiO_2 slag. Additions of MnO and FeO, up to 4% by weight, have little effect upon the rate. ***L. D. Kirkbride and G. Derge.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 87-94.

6888* Effect of Rare-Earth Additions on Some Stainless Steel Melting Variables. Rare-earth additions were made to laboratory heats of Type 310 stainless to observe their effect on as-cast ingot structure, N and S contents, and nonmetallic inclusions. Lanthanum had a grain-refining effect in 30-lb ingots, but results with 200-lb ingots were inconsistent. Cerium, La, and Mischmetal lowered the S content when the S exceeded 0.015% and the rare-earth addition was greater than 0.1%. The rare-earth content in the metal dropped very rapidly within the first few minutes after the addition. The size, shape, and distribution of nonmetallic inclusions was not changed in 30-lb ingots, but changes were noticed in larger ingots. ***Rudolph H. Gautschi and Frederick C. Langenberg.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 128-132.

6889 On the Mechanism of the Reduction of Iron Oxides. A study of lower oxides as catalysts of the semiconductor type and by process of "atomization" of elementary particles of iron on surface of iron oxides being reduced by gases. ***S. T. Rostovtsev, L. N. Rudenko, and B. K. Simonov.*** *Henry Brutcher Translation No.* 4692, 9 pp. (From *Nauchn. Doklady Vyssh. Shkoly - Metallurgiya,* no. 2, Mar.-Apr. 1959, p. 5-8.) Henry Brutcher, Altadena, Calif.

6890 Recent Advances in Steelmaking Practices at Watertown Arsenal. This discussion describes an extensive process evaluation of slag and metal characteristics and their effects on the properties of cast low alloy steels. ***John Zotos.*** *Foundry,* v. 88, Mar. 1960, p. 108-112.

6891 Low-Sulphur Steelmaking Proves Out on Tonnage Basis. For a new steelmaking process to succeed, it must meet the challenge of tonnage production. The rotary reactor process for desulfurizing steel can now lay claim to having made the grade. ***H. W. McQuaid.*** *Iron Age,* v. 185, no. 7, Feb. 18, 1960, p. 114-116.

6892 Pressure Treatment Up-Grades Teeming Ladle Nozzles. Erosion and failure of refractory nozzles have long been a problem during casting. Recent production line experience shows that pressure impregnation of nozzles can result in steel improvement equal to 2-8¢ per ton. ***G. M. Carvlin, Jr.*** *Iron Age,* v. 185, no. 8, Feb. 25, 1960, p. 68-70.

6893* Low-Load Blast Furnace for Iron Smelting. ***P. Vajragupta and P. Chotinuchit.*** *Iron & Steel,* v. 33, no. 2, Feb. 1960, p. 69-70.

6894 Oxygen and Steelmaking Process. A comparison of open hearth, LD, kaldo and rotor processes. ***E. F. Kurzinski.*** *Iron and Steel Engineer,* v. 37, Feb. 1960, p. 65-75.

6895 Modernization of the Seattle Plant. An extensive construction program at the Seattle plant of Bethlehem Steel increased tonnage capacity and provided means for producing quality steel. ***N. L. Bock and Kenneth Grant.*** *Iron and Steel Engineer,* v. 37, Feb. 1960, p. 77-87.

6896 Powder Lancing in Steel Mill Operations. Powder lancing is primarily a melting process rather than a burning process . . . as a result it can be readily used for piercing and cutting materials such as firebrick and concrete . . . it may offer a number of advantages in steel plant operation, particularly in maintenance and construction applications. ***C. B. Milton and L. F. Keel.*** *Iron and Steel Engineer,* v. 37, Feb. 1960, p. 95-101.

6897 Pilot Plant Studies New Direct Reduction Process. In a pilot plant at Indianola, Pa., Swindell-Dressler Corp. of Pittsburgh is developing a unique method for reducing iron ore directly into pig iron. *Iron and Steel Engineer,* v. 37, Feb. 1960, p. 149-150.

6898 Continuous Cycle Furnace Provides Better Grain Structure. ***A. G. Sturrock.*** *Iron and Steel Engineer,* v. 37, Feb. 1960, p. 152 + 1 page.

6899 Some Factors Affecting Fume Evolution From Molten Steel During Oxygen Injection. It was found that, in Fe-C melts the amount of fume evolved increases with the C content of the melt and the O input rate. Injection of air drastically reduces the quantity of fume produced but also seriously lessens the rate of C removal. ***K. Knaggs and J. M. Slater.*** *Iron and Steel Institute, Journal,* v. 193, pt. 3, Nov. 1959, p. 211-216.

6900 Fumes From the Acid Open-Hearth Process. The concentrations and compositions of fumes from the acid OH furnace process were determined at the various stages of the melting cycle. Although the chief constituents of the fume are magnetite and hematite, other metallic oxides and silica form an appreciable part of the fume. ***W. Strauss and M. W. Thring.*** *Iron and Steel Institute, Journal,* v. 193, pt. 3, Nov. 1959, p. 216-221.

6901 Modification of the Cast Structure of High-Speed Steel. The eutectic phase normally present in as-cast high-speed steels can be modified by a simple heating operation at a temperature in the region of the peritectic phase change. The process has been applied with success to small sections of various sized ingots and also to cast cutters, but at present there are practical difficulties in extending its use to commercial ingots and large sections. The technique may offer a method of restoring partially overheated (but not burnt) high-speed steel components. ***G. Hoyle and E. Ineson.*** *Iron and Steel Institute, Journal,* v. 193, pt. 3, Nov. 1959, p. 254-269.

6902 Distribution of Electrode Consumption in an Electric Arc Furnace. Measurements of the losses at the sides and the bottoms of 4 in. diameter graphite electrodes used in the B.I.S.R.A. ten cwt. experimental arc furnace indicate that during the melting period: (1) rate of electrode loss increases with electrode current; (2) fo ra given furnace voltage, rate of loss increases with power input; (3) for a given power input, rate of loss decreases with increase of furnace voltage; and (4) total electrode consumption decreases with increase of furnace voltage. The increase of the rate of electrode loss with increasing current is mainly due to increased bottom loss. Rates of loss during the subsequent steelmaking process were also measured. ***J. Ravenscroft and M. Preston.*** *Metallurgia,* v. 60, Dec. 1959, p. 253-259.

6903* Vacuum Degassing of Tin Bronzes. Laboratory tests with the vacuum degassing of liquid bronze were carried out on the unit consisting of a caisson where a graphite crucible with 30 kg molten metal (CuSn 10) was inserted and of two vacuum pumps with total output of 240 m^3/hour. Considerable reduction of gas content was obtained as well as an improvement of mechanical properties and a better corrosion resistance at high temperature. (*In Czech.*) Vakuové odplynění cínových bronzů. ***Zdeněk Motloch and Jiří Saip.*** *Slévárenství,* v. 8, no. 1; *Prace Ceskoslovenskeho Vyzkumu Slevarenskeho,* v. 7, no. 1, Jan. 1960, p. 33-38.

6904 Experimental and Theoretical Studies of the Solidification of Uranium Castings. Factors affecting the soundness of large cylindrical U ingots cast in graphite molds were studied by means of a mathematical model that describes the heat flow during solidification. An experimental technique to accurately measure the temperature at various locations within the solidifying ingot was also developed. This technique involved the use of Ceramo-type, platinum-platinum rhodium thermocouples shielded by small graphite tubes. Variations in pour time, superheat, mold preheat, and outer-mold-wall emissivity were examined by the mathematical model. ***Ellis L. Foster, Jr., Billie L. Fletcher, Charles K. Franklin, Andrew Lechler, and Ronald F. Dickerson.*** *U. S. Atomic Energy Commission, BMI*-1390, Oct. 28, 1959, 52 pp. (UF767 U3b Contin.)

6905 Development of the TBP-Hexane Process for Uranium Purification. Solvent choice, slurry extraction, wash and re-extraction, high U, low acid flowsheet, solvent treatment, TBP-recovery are discussed. ***W. C. Philoon, R. M. Edwards, and R. H. Farris.*** *U. S. Atomic Energy Commission, MCW*-1441, Feb. 1, 1960, 19 pp. (UF767 Un3.1mc Contin.)

See also: **7149** (electrowinning of W and Mo).

METALS—FINISHING, POLISHING, AND CLEANING

6906 The Electrolytic and Chemical Polishing of Metals in Research and Industry. The mechanism of electrolytic polishing, the electrical characteristics of the polishing process, influencing polishing conditions, laboratory and research applications of electrolytic polishing, general principles for laboratory methods, the use of perchloric acid, laboratory methods for specific metals and their alloys, and other problems are discussed. ***W. J. McG. Tegart.*** 2nd Edition. 139 pp. 1959. Pergamon Press, New York. (TS213 T23e2)

6907 Blast Barrel Automation Cuts Foundry Cleaning Costs. An automated blast cleaning barrel handles a wide range of types and sizes of work. Cleaning time is reduced from 20 to 8 minutes a load. Wear plates log 1200 hours. *Iron Age*, v. 185, no. 7, Feb. 18, 1960, p. 110-111.

See also: **6791** (ultrasonic cleaning of printing plates).

METALS—FOUNDRY PRACTICE

6908 Foundries Can Produce Their Own Cast Iron Directly From Ore. Foundries might use some recently developed direct-reduction processes for producing their Fe. Some of these processes are suitable for integration into a foundry to replace the conventional cupola facilities and other melting auxiliaries. Under some conditions which exist in iron foundries today, these processes can be used to produce and melt Fe more cheaply than by the present conventional methods. ***H. W. Lownie, Jr. and A. J. Stone.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 1-8. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6909 Some Foundry Problems in the Development of a New Marine Propeller Alloy. Material, melting, molding, refractories, fluxes, gas and feeding, are discussed as applied to Ni-Al-bronze. A comparison of engineering properties and service performances of the standard Mn bronze propeller alloy and the new superior Ni-Al-bronze is outlined. ***A. J. Smith.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 9-24. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6910 Sand Movement and Compaction in Green Sand Molding. A description of the principles controlling sand movement during squeezing, jolting and contour squeezing, and combinations of these, is given. The compaction process, and development of mechanical properties with increasing density, is also described. ***T. J. Bosworth, R. W. Heine, J. J. Parker, E. H. King, and J. S. Schumacher.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 47-55. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6911 Sample for Rapid Measurement of Gas in Aluminum. A rapid quantitative test for gas in Al has been developed. The gas content is determined by a single weighing of a 20-cc sample solidified at approximately 0.1 atmospheric pressure. The constant volume sample reduced pressure solidification test can provide a quantitative measure of the gas contained in a melt within 4½ min from sampling. ***H. V. Sulinski and S. Lipson.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 56-64. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6912 Rapid Hydrogen Determination for Steel Foundry Control. The method for the determination of H in steel uses the hot extraction technique for extracting H from steel, and employs a Pirani gage for the analysis of the extracted gases for H by the thermal conductivity technique. ***C. C. Carson and B. J. Alperin.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 70-74. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6913 Tempering Molding Sand. Test procedures for actual and compensated moisture tests are described. A method of determining the riddled density of sand is given. The higher-strength sand will produce a better finish casting with greater contour accuracy. ***H. W. Dietert, V. Rowell, and A. L. Graham.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 75-81. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6914 Specialized Foundry Statistical Controls Improve Customer Satisfaction. The development and installation of a total quality control program has been instrumental in reducing total hard- and soft-iron scrap from a 27-month average of 10.9%, to a full year of experience at 5.4% with still further gains anticipated. ***Buford M. Appleman.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 82-92. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6915 Dimensioning of Sand Casting Risers. Develops a new approach for risering sand castings whereby a general equation for risers is obtained. Using the equation, the size of riser or risers for a given casting can be easily found. The general equation is expressed in graphic form. ***Harish D. Merchant.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 93-105. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6916 Mold Material Effect on Cooling Rate and Physical Properties of Cast Metals. The results of the tests confirm the previous experimental work and show that increased coarseness of grain size and increased mold density increases tensile strength in all cases, when other variables are equal. Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 106-120. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6917 Interrelation Between Stress Concentration and Castability. There is a close relationship between shapes designed to minimum stress concentration, maximum load carrying ability and the castability of such shapes. The designer and foundryman are in basic agreement on this subject to the point that most, if not all, shapes designed for minimum stress concentration are shaped for maximum castability. ***J. B. Caine.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 121-124. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6918 Experimental Determination of Specific Surface and Grain Shape of Foundry Sands. With the new testing method described, the average grain shape of sand grain distributions, as well as of individual grain size fractions can be determined experimentally and reproducibly. ***Franz Hofmann.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 125-128. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6919 Design Engineering as Related to Magnesium Castings. The article treats the subjects of structural and casting

design separately, and then attempts objectively to relate the two. The results when applied to Mg can be a rather unique situation, where the best features from both structural and casting standpoints become indistinguishable. ***George H. Found.*** Paper from "American Foundrymen's Society, Transactions, v. 67, 1959, p. 143-148. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6920 Factors Influencing Soundness of Gray Iron Castings. A Review of Some Recent British Work. The constitution of nearly all gray irons leads to both contraction and expansion stages during their solidification, and soundness is to a large extent dependent upon the detailed way in which these volume changes act. Major composition of the iron also affects casting expansion and soundness by influencing the eutectic graphite amount. ***I. C. H. Hughes, K. E. L. Nicholas, A. G. Fuller, and T. J. Szajda.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 149-165. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6921 Starch Content Effect on a Rammed Graphitic Mold Material for Casting Titanium. It was found that the best combinations of properties were obtained with mixtures containing 6 to 8% starch. In addition, it has been found that mold shrinkage is directly proportional to starch content and inversely proportional to molding pressure. ***H. W. Antes and R. E. Edelman.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 173-178. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6922 Gray Iron Permanent Molding. Presents a short history of the origin and development of gray iron permanent molding, a description of the process and methods used in design and fabrication of the molds. ***H. U. McClelland.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 226-228. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6923 Green Tensile and Shear Strengths of Molding Sands. Knowledge of the tensile and shear strengths of molding sands, and principles controlling these properties, is necessary to the best utilization of green sand. Principles relating to tensile and shear properties, their relation to other green sand properties, and their connection with molding problems are discussed. ***R. W. Heine, E. H. King, and J. S. Schumacher.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 229-236. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6924 Hot Cracking Test for Light Metal Casting Alloys. A simple and reproducible test for determining the relative resistance to hot cracking of Al and Mg casting alloys is described. It is based on the fact that the probability for hot cracking to occur is greatest at a sharp internal angle, and diminishes as fillet radii of increasing sizes are provided. ***E. J. Gamber.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 237-241. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6925 Martensitic White Irons for Abrasion-Resistant Castings. Martensitic white iron castings are extensively used to resist abrasive wear in a wide variety of applications. Deals with a number of the important characteristics of the martensitic white irons, together with studies which have been made on a number of the more important variables influencing their structure, wear resistance, mechanical properties and resultant service life. ***T. E. Norman, A. Solomon, and D. V. Doane.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 242-256. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6926 Carbon Flotation in Ductile Iron. In hypereutectic ductile iron castings, C in excess of that necessary to maintain a C equivalent of 4.55%, was found to be precipitated during the solidification period. The precipitated C is floated to the top surface of the casting, where it is trapped, resulting in an area of high graphite nodule concentration. The flotation of C also occurs in the ladle. ***A. H. Rauch, J. B. Peck, and G. F. Thomas.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 263-266. American Foundrymen's Socity, Des Plaines, Illinois. (TS200 Am35t Vis.)

6927 Timing of Expansion Scab Formation. A step casting was designed for making a buckled or expansion scabbed casting. The tests showed that one type of scabs and/or buckles occurred because of sand expansion, and occurred at the time the mold was filling. ***J. E. Haller.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 267-270. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6928 Radioisotopes Utilization in the Foundry Industry. Applications of radioisotopes in the metals industry include measurement of wear of cutting tools, bearings, and refractory surfaces, tracing of chemical and physical species through complex processes, measurement of thickness of solid and fluid metal and surface coatings, corrosion, location of alloying elements in microstructure, and the diffusion of metals in alloys. ***M. Pobereskin and D. N. Sunderman.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 271-276. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6929 Deoxidation Defects in Steel Castings. Final Report for the AFS Steel Division Research Committee. Nonmetallic marcroinclusions, commonly described as "snotters," are a frequent cause of scrap or lead to inferior machinability of the cope surface of steel castings. Objectives of this investigation were to identify these inclusions, trace their origin in foundry practice, and suggest methods of elimination. Mechanical techniques of settling, skimming and trapping, as well as the use of complex deoxidants to form other deoxidation products, may offer solutions. ***R. A. Flinn and L. H. Van Vlack.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 295-299. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6930 Cast Surfaces Evaluation for Roughness Standards. MIL-STD-10A specifies the mathematical method of evaluating surface roughness, requiring a profile view of the surface. A photomicrograph of the edge is made and the surface evaluated by obtaining linear measurements in micro-inches from the photomicrograph. ***Eldon Swing.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 300-304. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6931 Porosity, Inclusions and Pinholes in Malleable Castings. Hot sands are believed to create a chain of reactions which become difficult to control. Other reasons for porosity or pinholes in malleable castings are those of improper melting practices. ***C. A. Sanders.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 305-313. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6932 Linear Programming Applied to Economic Selection of Materials for Furnace Charges. The linear programming technique can be used to choose that feasible material combination whose material cost is a minimum. The technique can be used to calculate optimum prescriptions for individual heats, or to determine which materials to buy to stock in inventory. This paper is concerned with the "what to buy" decision. ***Gideon I. Gartner.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 314-320. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6933 Copper in Cast Iron. Principal Considerations. A uniform structure is imparted to gray iron by the Cu additions. Thus, Cu additions offer a distinct advantage in relation to machinability and wear resistance which are important for the many applications and engineering properties of gray iron castings. ***Albert de Sy.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 321-328. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6934 New Foundry Resins and Application Techniques for Shell Molds and Shell Cores. The operational problems which are encountered when using shell molds and shell cores are peel back or drop off, poor casting finish, caking of coated sand, and thermal cracking. Corrective measures can be taken to overcome these difficulties. ***William C. Capehart.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 329-336. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6935 Ductile Iron Production in Basic Direct-Arc Furnace. Addition alloy cost savings, less reladling and a reduced tendency toward drossing are advantages gained by using a basic-lined direct-arc electric furnace for the production of ductile Fe. The use of a basic desulfurizing slag during meltdown upgrades the base Fe and preconditions it for the making of ductile Fe at low Mg residuals. ***C. R. Isleib.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 341-346. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6936 Proper Gating Through Use of Cobalt 60. Nondestructive testing by use of Co-60 radiography has helped the author's company improve the quality of their castings. The company makes a threefold use of this type of inspection: to check new casting design before production begins, to design gating layouts to produce highest quality castings at lowest cost, and to establish inspection standards. ***A. J. Karam.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 353-358. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6937 Steel Castings for the Aircraft Industry. Quality Requirements. In order to achieve optimum utilization of steel castings in the aircraft industry, which is required to keep up with the state of the art, several improvements must be made in the foundry practices. ***Y. J. Elizondo.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 359-365. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6938 Grain Refinement of Solidifying Metals by Vibrations. A number of different liquid metal compositions, including pure metals and alloys that solidify as solid solutions and eutectics, were vibrated under controlled solidifying conditions. Metallographic examination of the solidified ingots of these metals indicated that all were grain refined to some extent, although the amount of refinement varied considerably. ***R. G. Garlick and J. F. Wallace.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 366-374. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6939 Reclaim Sodium Silicate Bonded Sand. The objective of this project was to determine whether or not sodium silicate bonded sands could be reclaimed and, if so, what would be involved, and what could be expected as to repetitive dimensional accuracy of the sodium silicate bonded mold. A casting from green sand was compared for dimensional accuracy with a casting from sodium silicate bonded sand. ***George C. Warneke.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 375-379. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6940 Mottling in Heavy Section White Iron Castings. First Progress Report on an Investigation Sponsored by AFS Malleable Division. There is an increasing demand on malleable iron foundries to produce castings of a larger section size. However, the problems of producing the casting without mottling and with adequate annealability arise. The project is aimed at producing heavy section castings from an Fe of such composition and/or melting practice that mottling or primary graphitization will not occur during the freezing of the casting. ***C. R. Loper, Jr. and R. W. Heine.*** Paper from "American Foundrymen's Society, Transactions, v. 67, 1959, p. 380-384. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6941 Pressure Tightness of 85-5-5-5 Bronze. Relationship of Thermal Gradients During Solidifications. The data indicate that pressure tight castings were obtained in 2-in. square bar sections when the thermal gradient exceeded 60 F/in. By the use of tapered chills it was possible to attain this gradient in bars up to 9-in. in length. ***Richard A. Flinn and Chester R. Mielke.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 385-392. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6942 Method of Obtaining Castability and Maximum Field Service From Cast Products. The casting design must make the most efficient use of the metal in field use and also, have good castability in the foundry. The method of casting design outlined has proved to be a satisfactory engineering approach to obtaining these two desired end results. ***J. W. Beckham.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 393-396. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6943 Pinhole Occurrence in Malleable Castings. Bonding Clays as Cause. Pinholes in malleable castings are often caused by the evolution of water vapor from certain clay bonds in green sand molds when heated above 212 F by molten Fe. Foundry experience revealed that pinholes occur less often when illite, rather than other clay bonds, is used. ***D. R. Jones and R. E. Grim.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 397-400. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6944 Industrial Engineering for the Small Foundry. A Practical Approach. The small foundry is defined as one which has approximately 50 to 100 employees. It is advisable to bring in outside help on a consulting basis for the purpose of ascertaining facts and actual conditions, of devising a specific cost control plan, of training selected foundry personnel. ***F. E. Noggle.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 401-411. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6945 How to Avoid Sand Segregation. The problem of sand segregation was studied, with particular reference to the loading and unloading. Sands colored to indicate fineness were used in the tests. Recommendations based on the results of these tests are given. Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 412-414. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6946 High Strength Steel Castings. Mechanical Properties and Processing Techniques. Properties of arc furnace and induction melted material were compared, and the effectiveness of certain heat treatments were assessed. Best combination of strength, ductility, and toughness was obtained in thin sections of low S and P steel cast from arc furnace heats. ***K. D. Holmes, J. Zotos, and P. J. Ahearn.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 415-420. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6947 Core Boxes for Shell Cores. The use of gray iron shell core boxes is discussed, showing reasons why the author's company uses this metal in preference to Al. Some of the provisions necessary when using gray iron are given, as well as the use record of some of the boxes. ***J. E. Stock.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 421-422. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6948 Tin Effect on Structure and Properties of Flake and Nodular Graphite Cast Irons. The paper reviews previous work on the effect of Sn on flake and nodular graphite cast irons. New results on the effect of Sn on the promotion of pearlite matrices in two nodular irons are presented. ***E. C. Ellwood.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 423-430. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6949 Cyclic Permanent Mold Operation. Some Thermal Aspects. It was found that mold temperatures, casting solidification rates and permissible speeds of operation are influenced considerably more by casting thickness than by mold thickness. For any selected production rate mold temperatures will be lower and solidification more rapid in thick molds than in thin molds. ***C. L. Goodwin and H. Y. Hunsicker.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 431-435. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6950 Crust Separation Test for Investigating Sand Expansion Defects. The development of a new technique for studying expansion defects is described, together with some applications of the technique. It has been shown that expansion failures can occur at relatively low temperatures at which sand expansion is in the range 0.25–0.7%, and in the presence of wood flour in excess of 3%. ***P. W. Goad.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 436-448. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6951 Solidification Times of Simple Shaped Castings in Sand Molds. I. Literature Review and Preliminary Work. II. Size and Shape Effect on Solidification Time. III. Mold Material Effects. A critical review of experimental and theoretical work concerned with the time of solidification of

simple sand-cast shapes reveals the existence of many controversial points. These arise through the several assumptions made in the basic mathematical treatments of the rate of solidification when applied to sand-cast shapes. The assumptions generally made in these equations have been re-examined in this work, and certain experiments carried out to check them. A prediction of the solidification times for the particular range of sizes and shapes examined, has been shown to be generally possible. The chilling power of several mold materials under various conditions of the mold have been determined by a calorimetric method. ***J. Berry, V. Kondic, and G. Martin.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 449-476. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6952 Some Principles for Producing Sound Al-7Mg Alloy Castings. Principles were developed from a study of the relationship that exists between the thermal gradients at the center line of the casting, and various conditions such as the size of the casting as well as the location of gates, risers, and chills. It was found that the feeding range of a side riser decreased as the section thickness increased. Unsoundness occurred when the thermal gradients fell below 5 F per in. The feeding range of an end riser was increased by 50% or more by using wedge-shaped chills on the drag surface of the casting. ***W. H. Johnson and J. G. Kura.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 535-552. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6953 Transactions of the American Foundrymen's Society, Proceedings of the Sixty-Third Annual Meeting, April 13-17, 1959. American Foundrymen's Society, Transactions, (Annual Volume), v. 67, 772 pp. 1959. American Foundrymen's Soicety, Des Plaines, Illinois. (TS200 Am35t Vis.)

6954 Freezing of a Growing Liquid Column. The one-dimensional problem is treated in which a liquid metal column, of the original temperature θ_o, is supplied with additional metal at the top, of temperature θ_b, at the rate v ft/min. At the bottom of the column a heat sink of temperature θ_a is maintained. The case in which θ_a exceeds the fusion temperature is solved for v = const, both rigorously and approximately. ***G. Horvay.*** *ASME, Transactions, Series C, Journal of Heat Transfer,* v. 82, no. 1, Feb. 1960, p. 37-47.

6955 Pouring Castings in Ungassed Sodium Silicate-Bonded Molds. The technique was developed to meet demands for improved casting finish without use of varied sand mixes. ***W. G. Probst, III and Gerald R. Scott.*** *Foundry,* v. 88, Mar. 1960, p. 82-85.

6956 Aluminum Automotive Castings. Because of the high cost of diecasting dies, there is a very real need for improved and cheaper methods of making die cavities. Especially if more than one die is required, the use of precision cast dies appears very promising. ***Robert F. Thomson.*** *Foundry,* v. 88, Mar. 1960, p. 86-89.

6957 Risering of Ductile Iron Castings. Freezing, shrinkage, and feeding distance characteristics of ductile iron are discussed in relation to risering requirements in dry and green sand molds. ***R. W. White.*** *Foundry,* v. 88, Mar. 1960, p. 96-102.

6958* Vacuum Melting and Casting. Teeming Methods and Influence of Pressure. ***K. G. Lewis.*** *Iron & Steel,* v. 33, no. 2, Feb. 1960, p. 47-52.

6959* X-Ray Perfect Castings. Akron Gravity Casting Co. uses the Wessel System of pouring Al, calling for closely controlled cycle in the production of high density permanent mold casting with excellent surface finish. ***E. I. Peck.*** *Modern Metals,* v. 16, no. 1, Feb. 1960, p. 40.

6960* How Unit Dies Slashed Downtime on G.E.'s Casting Machines. Downtime of two hours or more did much to discourage multipart die casting of fairly short runs. But the unit die principle cuts downtime to 15 or 20 minutes; makes short runs feasible. ***John H. Mills.*** *Modern Metals,* v. 16, no. 1, Feb. 1960, p. 60 + 1 page.

6961 Centrifugal Casting of Aluminum-Uranium Alloys. With the equipment employed it was found that the best castings were produced utilizing a pouring temperature of 2400 F, a heavy-walled steel cylinder rotating between 700 to 900 rpm for the mold and a bottom-pouring technique employing a retractable pouring spout. ***Norman E. Daniel, Ellis L. Foster, Jr., and Ronald F. Dickerson.*** *U. S. Atomic Energy Commission, BMI-1363,* July 20, 1959, 26 pp. (UF767 U3b Contin.)

See also: **6206** (light metal castings for aircraft); **6366** (analysis of cast iron); **6973** (effect of Mo on gray iron); **6975** (strength of gray irons); **6976** (tensile strength of ductile iron).

METALS—HEAT TREATMENT

6962 Modern Quenching Oils and Techniques for Foundry Heat Treating. The increasing importance of, and variables affecting, the quenching phase of heat-treating steels is discussed. The conventional quench, marquench and modified marquench are dealt with, giving pertinent data for each. Case histories showing results of using an additive-type quenching oil medium are presented. ***N. F. Squire.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 30-34. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6963 Heat Treatment of Ductile Iron. It is the purpose of this paper to cover the three types of treatment set up to process the castings: first, a full ferritizing anneal; second, a sub-critical draw for machinability retaining the "as cast" tensile properties; and third, a two temperature normalizing in the interests of machinability for small castings. ***W. D. McMillan.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 215-216. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6964 Spark-Hardening of Metals. Steel surfaces are hardened by the thermal cycling, but evidence is given that elements derived from the sparking medium accentuate the hardness change. Surface alloying also occurs by the transfer of matter between the sparking contacts, and experiments with sintered-carbide electrodes show that very hard, wear-resistant layers can be formed on most engineering metals. ***N. C. Welsh.*** *Institute of Metals, Journal,* v. 88, pt. 3, Nov. 1959, p. 103-111.

6965 The Influence of Prior Heat-Treatment on Recrystallization of Commercial Aluminium. Intermediate soaking at 500 C, as compared with soaking at lower temperatures, retards softening and recrystallization during the final anneal and favors the formation of coarse, imperfect grains. These effects are attributed to the presence of greater amounts of impurities in solution, the higher the intermediate annealing temperature. ***T. L. Richards and S. F. Pugh.*** *Institute of Metals, Journal,* v. 88, pt. 3, Nov. 1959, p. 141-143.

6966 Titanium Sheet Gets Heat-Treat. New heat-treat process for Ti makes possible high-strength, light-gage sheets. *Iron Age,* v. 185, no. 8, Feb. 25, 1960, p. 71.

6967 Titanium Heat Treat Process Gives High Strength in Light Gages. The new heat treated Ti sheet is described as particularly attractive to the aviation industry, since it can be utilized in thinner gages, and therefore lighter weight, while still holding to required strength ratings. *Iron and Steel Engineer,* v. 37, Feb. 1960, p. 143.

6968* Treatment of a 1% Carbon Spring Steel. Effect of Scale Removal Prior to Reheating for Quenching. An investigation into the effect of descaling prior to reheating for quenching on the decarburization, hardenability and torsional fatigue properties of a C steel used for hot-formed springs is described. ***J. W. Mee.*** *Metal Treatment and Drop Forging,* v. 27, Feb. 1960, p. 45-49.

6969* Temperature Uniformity in Heat Treating. Rapid, uniform heating of charges of ferrous parts to temperatures within the critical range for carburizing, carbonitriding, or bright hardening can be effectively carried out by convection. ***Harold N. Ipsen.*** *Metal Treatment and Drop Forging,* v. 27, Feb. 1960, p. 63-66.

6970 Age Hardening of Chemical Nickel Coatings. The Ni coating process discussed is an "electroless plating" technique by which Ni cations are reduced at a catalytic surface to the metal by hypophosphite anions. The process has the advantage of great solution stability and prolonged bath life, higher rate of deposition, better appearance of the plating and superior adhesion over the original bath formulations. ***Warren G. Lee.*** *Plating*, v. 47, Mar. 1960, p. 288-290.

6971 Relaxation Characteristics of Inconel at Elevated Temperatures. A stress-relaxation machine has been developed capable of providing very precise results throughout the useful temperature range of common structural metals. It was demonstrated that with the use of a single specimen and relatively short testing times, a complete set of stress-strain rate values can be obtained at any desired temperature. ***C. R. Kennedy and D. A. Douglas.*** *U. S. Atomic Energy Commission, ORNL-2407*, Feb. 12, 1960, 29 pp. (UF767 U3o Contin.)

6972* Modern Methods of Annealing Wire. General annealing procedures and methods of application. ***F. Frodsham.*** *Wire and Wire Products*, v. 35, Feb. 1960, p. 205 + 6 pages.

See also: **7027** (annealing of point defects in cold-worked tungsten).

METALS—MECHANICAL AND PHYSICAL PROPERTIES

6973 Molybdenum Effect on Gray Iron Elevated Temperature Properties. The effect of up to 2.0% Mo on the short-time tensile and stress-rupture properties of a 3.8% C equivalent gray iron has been determined by various additions of that alloy to two base irons: one with only residual alloys; and another containing approximately 0.60% Cr. Increasing Mo additions generally resulted in greatly improved high-temperature properties at all testing temperatures. The stress-rupture properties of the irons containing Cr were superior to the straight Mo irons. ***G. K. Turnbull and J. F. Wallace.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 35-36. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6974 Bending Techniques for Evaluation of Cast Materials and Structures. A Preliminary Appraisal. A cast bending specimen is described, and the test results for 28 different conditions of chemistry and heat treatment in Al and Mg alloy are given. A machined bending bar is described and its results on the 28 different conditions are given. ***J. C. Graddy.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 166-172. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6975 Ductility and Strength of High-Carbon Gray Irons. Irons melted by cupola, induction and blast furnace were included in the study. The criterion of ductility was the total elongation reached before fracture. Ductility decreased with increasing Mn contents above 0.5%. ***E. M. Stein and H. O. McIntire.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 179-186. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6976 Ductile Iron. As-Cast and Annealed Tensile Properties. Significant relationships exist between tensile properties and Brinell hardness in as-cast pearlitic-ferritic ductile iron. However, these relationships are strongly affected by changes in composition of the iron. ***A. H. Rauch, J. B. Peck, and E. M. McCullough.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 187-192. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6977 Malleable Iron, a Magnetic Alloy. Malleable iron is well-known for its strength, toughness, and machinability. It also has excellent magnetic properties, and although it has been specified for electromagnetic applications, designers have not had, in one place, data available to them on the magnetic properties. This paper is presented to correct that situation. ***W. K. Bock.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 199-206. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6978 Electrical Conductivity of Sand-Cast Copper-Base Alloys. Gives electrical conductivities for the standard ASTM cast Cu-base alloys, plus many other cast Cu-base alloys. The effect of alloying elements on the electrical conductivities of the various classes of sand-cast Cu-base alloys is illustrated. ***D. G. Schmidt and F. L. Riddell.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 207-214. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

6979* The Effect of Zirconium on the Properties of Extruded Magnesium-Rare Earth Metal Alloys. Zirconium additions to Mg-rare earth metal alloys have little effect on the properties of extrusions. Higher strength properties and creep resistance are found in extruded alloys containing Didymium than in those alloys containing Mischmetal. Additions of two to four per cent Zn to Mg-rare earth metal-Zr alloys do not appear promising for wrought products. ***J. F. Pashak and T. E. Leontis.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 1, Feb. 1960, p. 102-107.

6980 The Influence of Surface Residual Stress on Fatigue Limit of Titanium. Investigation of the effect of surface residual stress on the endurance limit of 6A1-4V-Ti alloy shows that this effect is equal within experimental error to the residual stress divided by a constant. Results can be expressed by a simple equation. A value for the constant is derived. ***E. C. Reed and J. A. Viens.*** *ASME, Transactions, Series B, Journal of Engineering for Industry*, v. 82, no. 1, Feb. 1960, p. 76-78.

6981 Rotational Hysteresis Loss in Grain-Oriented Silicon-Iron. An improved torque magnetometer was used to measure accurately the rotational hysteresis loss in grain-oriented Si-Fe for various percentage orientations and thicknesses. The experimental results are discussed in terms of multidomain concepts and of the Stoner-Wohlfarth single-domain particle, of which the rotational-hysteresis behavior was evaluated. The possible relevance of this theory and its extensions to the experimental results are considered. ***W. F. Archenhold, H. F. Sandham, and J. E. Thompson.*** *British Journal of Applied Physics*, v. 11, Jan. 1960, p. 46-49.

6982 Fracture. Proceedings of an International Conference on the atomic mechanisms of fracture held in Swampscott, Massachusetts, April 12-16, 1959. Papers cover theoretical and microstructural aspects of fractures in metals, glass, and plastics. ***B. L. Averbach, D. K. Felbeck, G. T. Hahn, and D. A. Thomas, editors.*** 646 pp. 1959. John Wiley & Sons, New York. (TA405 In8f)

6983 The Variation With Temperature of Young's Modulus for Some Uranium Alloys and for Thorium, Vanadium, and Niobium. ***D. J. Livesey.*** *Institute of Metals, Journal*, v. 88, pt. 3, Nov. 1959, p. 144.

6984 The Embrittlement of Aluminium-Magnesium Alloys by Sodium. The hot-working properties of the high-Mg Al-Mg alloys are severely impaired by the presence of traces of Na of the order of 0·001%. The constitutional factors involved were investigated, and it is shown that these particular alloys are susceptible to embrittlement because the Na present in them is in the elementary state. ***C. E. Ransley and D. E. J. Talbot.*** *Institute of Metals, Journal*, v. 88, pt. 4, Dec. 1959, p. 150-158.

6985 Hardness Changes in Cold-Worked Aluminium Alloys During Short Ageing Treatments. Certain binary Al alloys exhibit rapid softening on aging for a few minutes at elevated temperatures, after being cold worked at room temperature. The effect is explained in terms of the unlocking of the dislocations from the solute atmospheres that form during deformation. The mechanism is consistent with the well-known effects of deformation upon the course of age-hardening, i.e., peak hardness is reached at shorter times than in undeformed alloys and a higher maximum hardness is obtained by cold working after, rather than before aging. ***N. Gane and R. N. Parkins.*** *Institute of Metals, Journal*, v. 88, pt. 4, Dec. 1959, p. 173-176.

6986 Fatigue Damage and Crack Formation in Pure Aluminium. A statistical study was made of the effects of intermediate annealing on fatigue life of Al specimens tested in alternating torsion. Annealing at various stages of the fatigue

life proves to have no significant effect on the total life to fracture. However, periodic removal of the surface layers during the test enables the fatigue life to be extended considerably. It is concluded that fatigue cracks initiate at the free surface of an even, axially stressed specimen. ***D. R. Harries and G. C. Smith.*** *Institute of Metals, Journal*, v. 88, pt. 4, Dec. 1959, p. 182-185.

6987* Some Measurements on the Thermoelectric Power of Plutonium Metal. The thermal e.m.f. of a Pu-Pt thermocouple was measured and the absolute thermoelectric power of Pu in its six allotropic modifications calculated over their stable temperature range. The implications of the results in relation to the form of the density of states/energy curve at the Fermi surface are discussed. ***J. A. Lee and R. O. A. Hall.*** *Journal of the Less-Common Metals*, v. 1, no. 5, Oct. 1959, p. 356-361.

6988* An Interpretation of Some of the Properties of the Transition Metals and Their Alloys. The hypothesis is put forward that many of the properties of the transition metals can be interpreted in terms of a relationship between the co-ordination number of the metal atoms and the number of bonding electrons per atom. The electron resonance contribution to the bond strength is a maximum when the number of bonding electrons per atom is approximately equal to half the effective co-ordination number and it is postulated that the stability of this arrangement dictates very largely the alloying behavior and crystal structure. The alloying behavior of transition metals and their interaction with H and other interstitial elements are considered in relation to the hypothesis. ***D. A. Robins.*** *Journal of the Less-Common Metals*, v. 1, no. 5, Oct. 1959, p. 396-410.

6989* Effects of Ferrite and Sigma Phase on the Properties of Austenitic Chromium-Nickel Steels, and Particularly of Aircraft Material LW 1670. Formation of ferrite and origin of sigma phase; their influence on strength, corrosion, hot forming and weldability. In steel LW 1670 ferrite contents up to 3% cause no brittleness even after long annealing between 600 and 700 C, and even when there is a complete transformation of the ferrite in the sigma phase. *(In German.)* Einfluss des Ferrits und der Sigmaphase auf die Eigenschaften austenitischer Chrom-Nickel-Stähle, insbesondere des Luftfahrt-Werkstoffes LW 1670. ***Herbert Tauscher and Horst Buchholz,*** *Neue Hütte*, v. 4, Dec. 1959, p. 716-725.

6990* Embrittlement of High-Temperature Austenitic Steels. Formation of the carbides $Me_{23}C_6$ and MeC in austenitic steels as a function of time and temperature; constitutional diagrams of Cr-Ni steels and of the various alloying constituents and their relation to embrittlement; formation of martensite, ferrite, sigma and epsilon phases; the progress of embrittlement with time, depending on load and temperature. (*In German.*) Zur Versprödung warmfester austenitischer Stähle. ***Gerhard Krüger.*** *Neue Hütte*, v. 4, Dec. 1959, p. 725-733.

6991 The Magnetic Susceptibility of Vanadium Between 20 and 293 K. Four samples of pure V were prepared by different methods. There appears to be no systematic dependence of susceptibility on the method of preparation but the values obtained are appreciably larger than those reported by previous workers. The reason for this difference is discussed in terms of the impurity contents of the V used in the earlier work. ***B. G. Childs, W. E. Gardner, and J. Penfold.*** *Philosophical Magazine*, v. 4, ser. 8, Oct. 1959, p. 1126-1130.

6992 Extension of the Theory of the Effects of Anisotropic Relaxation Times on the Hall Coefficients of Some Dilute Alloys of Silver. *J. R. A. Cooper and S. Raimes.* *Philosophical Magazine*, v. 4, ser. 8, Oct. 1959, p. 1149-1154.

6993 The Plastic Deformation of Single Crystals of an Aluminium-Silver Alloy. Tensile tests were carried out at temperatures of 77 to 373 K on single crystals Al-20 wt.% Ag alloy. The crystals were aged either at room temperature or at 160 C, within the cold-hardening range. Single crystals of this material are very ductile. Stress-strain curves were obtained and the change of flow stress with temperature, during deformation, was measured and compared with the change of elastic modulus over the same temperature range. Observations were made with the optical microscope of the appearance of slip lines on polished surfaces of the specimens. ***A. Kelly, A. Lassila, and S. Sato.*** *Philosophical Magazine*, v. 4, ser. 8, Nov. 1959, p. 1260-1277.

6994 Superparamagnetism, Nonrandomness, and Irradiation Effects in Cu-Ni Alloys. The effect of neutron irradiation was investigated by means of magnetic susceptibility measurements. The susceptibilities were measured by the Gouy method between 300 and 2.0 K for a series of alloys ranging from 17.22 to 46.5 at.% Ni. It is shown that without superparamagnetism an unreasonable magnetic moment per Ni atom has to be assumed. ***F. M. Ryan, E. W. Pugh, and R. Smoluchowski.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1106-1112.

6995* Brittleness of Cast Steel With 13% Chromium. Kaplan turbine blades were cast of 13% Cr steels. At slow cooling from the tempering temperature brittleness occurs, which substantially decreases the impact resistance. By rapid cooling from the tempering temperature, impact resistance can be increased. (*In Czech.*) Křehkost 13 procentních chromových ocelí na odlitky. ***Adolf Lorenc and Přemysl Fremunt.*** *Slévárenství*, v. 8, no. 1, Jan. 1960, p. 5-8.

6996 An Autographic Elevated Temperature Creep Testing Facility. The described apparatus provides an autographic strain record using commercially available equipment, reliable temperature control for both constant or programed cyclic temperatures, and oxidation protection by means of specimen encapsulation. ***Robert L. Hammel and Robert E. Uhrig.*** *U. S. Atomic Energy Commission, IS-66*, Nov. 1959, 23 pp. (UF767 Un3.1isu Contin.)

6997 Prediction of High Temperature Tensile and Creep Properties From Hot Hardness Tests of a Zr-Nb-Sn Alloy. A method is described by which long-time creep properties can be predicted by using hot hardness data on a Larson-Miller, time-temperature parameter. ***D. L. Douglass.*** *U. S. Atomic Energy Commission, KAPL-2051*, Aug. 13, 1959, 8 pp. (UF767 Un3.1ka Contin.)

6998 Measurement and Interpretation of Electrical Properties of Zirconium Hydride for Hydrogen-To-Metal Ratios Between 1.5 and 2. Electrical resistivity and Hall effect measurements were carried out between 1.1 and 300 K on Zr hydride for H-to-metal ratios ranging from 1.54 to 1.96. In addition, the thermoelectric power was determined between 0 and 100 C. The data support the belief that for these compositions Zr hydride is a metallic compound. ***P. W. Bickel.*** *U. S. Atomic Energy Commission, NAA-SR-4173*, Jan. 15, 1960, 8 pp. (UF767 Un3.1na Contin.)

6999 Crack Propagation Tests of High-Strength Sheet Materials. III. Low-Alloy Air-Hardening Steel. The results of crack propagation tests, using center-cracked sheet tensile specimens, 0.5 inch wide and 0.75 inch thick, are presented for a proprietary, low-alloy, air-hardening steel (0.4% C, Cr-Mo-V), capable of being heat-treated to a tensile yield strength of at least 230 ksi. In this condition of highest strength the fracture-appearance transition temperature (FATT) was 200 F and the net fracture stress was much less than the yield strength at all temperatures in the range −200 to +500 F. Considerable improvements in these features were obtained by the use of two other tempering treatments. ***J. E. Srawley and C. D. Beachem.*** *U. S. Office of Naval Research. NRL Report* 5348, July 30, 1959, 12 pp. (T21 Un3.5n Contin.)

7000 Hydrogen-Embrittlement Susceptibility of Some Steels and Nonferrous Alloys. A number of steels and nonferrous alloys were tested to determine their comparative susceptibilities to H embrittlement. The criterion used was the ratio of the lowest nominal stress at which a H-charged notched tensile specimen fractured within 100 hours (the "static-fatigue limit") to the notched tensile strength of the uncharged material. Severe conditions of electrolytic charging were used (24 hours at 0.5 amp per square inch) so that a very slight degree of susceptibility might be detected. ***J. E. Srawley.*** *U. S. Office of Naval Research. NRL Report* 5392, Oct. 19, 1959, 25 pp. (T21 Un3.5n Contin.)

See also: **6946** (mechanical properties of steel castings).

METALS—MECHANICAL WORKING

7001 Gray Cast Iron Machinability. Quantitative Measurements of Pearlite and Graphite Effects. Common types of unalloyed cupola-melted gray cast iron were studied to determine how changes in some of the major constituents of their microstructures affected machinability. The objective of the study was to make a contribution to the understanding of fundamental and basic factors affecting the machining ease of gray cast iron. ***W. W. Moore and J. O. Lord.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 193-198. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

7002 Shear-Zone Size, Compressive Stress, and Shear Strain in Metal-Cutting and Their Effects on Mean Shear-Flow Stress. A relationship for the calculation of the shear-zone size is given. The shear-zone size, when machining SAE 1015, 118-Bhn seamless steel tubing under a wide range of cutting conditions, is found to vary from 0.95×10^{-6} in.^{3} to 61.5×10^{-6} in.^{3}. The mean shear-flow stress is found to increase significantly with a decrease in the shear-zone size and with an increase in the compressive stress in the shear zone. It is concluded that the only size effect in metal-cutting is the shear-zone size effect, and that no separate depth-of-cut size effect should be sought. ***Dimitri Kececioglu.*** *ASME, Transactions, Series B, Journal of Engineering for Industry*, v. 82, no. 1, Feb. 1960, p. 79-86.

7003 Mechanics of the Sheet-Bending Process. Two sets of expressions are obtained for residual stresses and deformations resulting from bending processes in which initially flat sheets are permanently deformed to sheets having finite radii of curvature. One of these sets applies for sheets whose concave surfaces have radii of curvature under load which are greater than 0.84 times the sheet thickness, and is associated with a residual plastic zone in the interior of the sheet. The other set applies whenever the afore-mentioned radii of curvature are less than 0.84 times the sheet thickness, and is associated with residual plastic zones in the bar interior and near the concave boundary of the sheet. ***Bernard W. Shaffer and Eric E. Ungar.*** *ASME, Transactions, Series E, Journal of Applied Mechanics*, v. 27, no. 1, Mar. 1960, p. 34-40.

7004* The Inspection and Maintenance of Diamond Wire-Drawing Dies. Inspection, cleaning, and examination; looking for faults; diamond powders; machines; treatment of faults; record of die performance. *Industrial Diamond Review*, v. 20, Jan. 1960, p. 14-18.

7005 Further Experiments on the Cold Extrusion of Metals Using Lubrication at Slow Speeds. Copper and two Al alloys possessing different strain-hardening characteristics were cold extruded with lubrication at a slow speed (0.44 in./min), over as wide a range of die angles and extrusion ratios as was practicable. Inverted-extrusion pressures for these materials, calculated from an empirical equation derived from earlier experiments, agree with experimental values within ± 7%. This equation is applicable over a wide range of conditions to a number of very different materials extruded cold at slow speeds. ***R. J. Wilcox and P. W. Whitton.*** *Institute of Metals, Journal*, v. 88, pt. 4, Dec. 1959, p. 145-149.

7006* Precision Bending With Dies. Considers factors involved in die-bending and suggests methods to improve precision. ***Federico Strasser.*** Iron & Steel, v. 33, no. 2, Feb. 1960, p. 65-68.

7007 Heat Reflectors in Forging. It was found that a bar inside a tube can cool up to four times more slowly than in air. Although the effects were less marked when using reflectors to shield hot steel during actual forging operations, an increase of about 50% in the available forging time (without reheating) was obtained when cogging square bars. ***A. R. Hardy and J. D. Stringer.*** *Iron and Steel Institute, Journal*, v. 193, pt. 3, Nov. 1959, p. 227-231.

7008 Experimental Semi-Automatic Forge. Describes an experimental forge comprising a 200-ton press and rail-mounted manipulator built as part of a program of research into the forging operation, and the development of automation of the process. ***J. I. T. Green and J. D. Stringer.*** *Iron and Steel Institute, Journal*, v. 193, pt. 3, Nov. 1959, p. 231-237.

7009 Heating for Forging in a Batch-Type Furnace. The efficiency of a forge furnace depends upon its shape, size, and material of construction, the burner design and method of waste-heat recovery. The way that the furnace is operated also greatly influences its efficiency. The furnace should be loaded at its designed capacity and the furnace temperature controlled to give the maximum permissible heating rates and the minimum soaking times. ***P. C. Finlayson and J. S. Schofield.*** *Iron and Steel Institute, Journal*, v. 193, pt. 3, Nov. 1959, p. 238-252.

7010 The Extrusion of High-Speed Steel Sections. Ingots of 18-4-1 high-speed steel can be extruded to round or flat bars at temperatures ranging from 1150 to 1280 C, with extrusion ratios up to at least 54:1. Extrusion from temperatures between 1250 and 1280 C appeared to promote improved carbide distribution, particularly when an extended heating time was used. ***P. J. Sukolski and G. Hoyle.*** *Iron and Steel Institute, Journal*, v. 193, pt. 3, Nov. 1959, p. 270-277.

7011 The Extrusion of Steel Tubes. Describes the hot extrusion of steel tubes by the direct method, using hydraulically operated horizontal presses. Also deals with raw materials, billet preparation, the heating of the billets, and lubrication of the tools; points out some advantages over other methods of hot-working. Reference is made to tool steels and tool designs, and to some of the problems that arise. ***J. W. R. Naden.*** *Iron and Steel Institute, Journal*, v. 193, pt. 3, Nov. 1959, p. 278-284.

7012 The Cold Extrusion of Steel. The Royal Ordnance Factory, Birtley, England, has been engaged for some years in developing cold extrusion practices and techniques; the process and its pitfalls are described in an endeavour to guide those entering this field. ***R. A. P. Morgan.*** *Iron and Steel Institute, Journal*, v. 193, pt. 3, Nov. 1959, p. 285-303.

7013* Calculation of Roll Force in Cold Rolling of Strip. Analysis of the factors influencing the roll force in cold rolling. Empirical methods for roll force calculation. The limit of rollability correlation between experimental and calculated data for different types of steel. Choice of formula in different cases. (*In Swedish.*) Beräkning av valstryck vid kallvalsning av band. ***P. O. Strandell.*** *Jernkontorets Annaler*, v. 143, no. 12, 1959, p. 810-892.

7014 Factors Affecting Temperature During the Extrusion of Non-Ferrous Metals. Considers the heat balance during extrusion under a range of conditions, and examines the progress made in controlling temperature variations. ***A. R. E. Singer and J. W. Coakham.*** *Metallurgia*, v. 60, Dec. 1959, p. 239-246.

7015* The Hot Extrusion of Non-Ferrous Metals. Comprehensive review of methods, equipment, and characteristics of extrusions of Cu, Pb, Al, Mg, Zn, Ni, Ti, and other alloys. ***Richard Chadwick.*** *Metallurgical Reviews*, v. 4, no. 15, 1959, p. 189-255 + 8 plates.

7016 Semiautomatic Carbon Arc Gouging Machine. The carbon Arc gouging machine replaces manually-operated oxy-acetylene scarfing equipment previously used to open welded flanged joints of large steel vessels. Its use resulted in 60% and 75% reductions in equipment operating costs. ***J. J. Maginnis, J. L. Irons, and T. R. Rutkay.*** *U. S. Atomic Energy Commission*, K-1443, Feb. 12, 1960, 20 pp. (UF767 Un3.1k Contin.)

7017* The Drawing of High Carbon Steel Wire at High Speed. Equipment, methods, and costs. ***W. Holloway, Jr.*** *Wire and Wire Products*, v. 35, Feb. 1960, p. 199 + 2 pages.

METALS—METALLOGRAPHY, TRANSFORMATIONS, AND STRUCTURES

7018 Intermetallic Reactions and Ageing Effects in Thin Films. Preparation of alloy films; diffusion in thin films; electron diffraction; X-ray methods; electrical resistivity; age-hardening in thin films; and diffusion measurements. ***C. Weaver and R. M. Hill.*** *Advances in Physics*, v. 8, no. 32, Oct. 1959, p. 375-437.

7019* The Solubility of Copper in Ferrite. The solubility of Cu in α-iron between 698 and 841 C was determined by a direct method of saturation and chemical analysis; Fe and Cu

(containing Ag) were equilibrated using iodide carrier in sealed Vycor capsules. ***H. A. Wriedt and L. S. Darken.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 30-36.

7020* An Acoustical Study of Low-Temperature Age-Hardening After Reversion in Al-6 At. Pct Ag. An acoustical method was used to study G.P. zone formation below 100 C during aging after the quench and reaging after reversion in two Al-6 at.% Ag single crystals. An analysis of the kinetics is presented which shows reaging to be rather complex. The direct-aging results of other workers are analyzed and confirmed. ***Herbert Herman and Morris E. Fine.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 44-50.

7021* Effect of Solute Impurities on Preferred Orientation in Annealed High-Purity Lead. New grains, introduced by recrystallization, were allowed to grow competitively at the expense of the substructure of a melt-grown single crystal. It was found that the development of preferred orientation relationships is dependent upon both the kind and the amount of solute present in the sample. ***K. T. Aust and J. W. Rutter.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 50-54.

7022* Directional Freezing of Magnesium Alloys. Directional freezing experiments on dilute magnesium alloys are described. Effective distribution coefficients were determined for binary and polynary magnesium alloys containing Al, Cu, Ni, Pb, Sn, and Zn. At slow rates of solidification, the calculated coefficients are independent of freezing rate. Application of the effective distribution coefficient to calculate the solidus in a dilute system is given. ***A. S. Yue and J. B. Clark.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 55-58.

7023* Some Devices for Quantitative Metallography. A traverse-integrating stage was constructed for making quantitative measurements of the volume fractions of phases in a metallographic sample. A nomograph was devised for use in determining phase boundaries in binary systems by quantitative metallography. A device was constructed for studies of preferred orientation of microscopically visible features and for collecting statistics on dihedral angles. ***Cyril Stanley Smith.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 58-62.

7024* Activity of Carbon in Iron-Nickel Alloys at 1000°C. The C content of 10 iron-nickel alloys ranging initially from purified Fe to purified Ni was determined at four fixed activities of C by equilibration with each of four CO-CO_2 atmospheres at 1000 C. At a fixed activity of C, the C content decreases with increasing Ni content to about 72% Ni, then increases to 100% Ni. This minimum solubility corresponding to a maximum activity coefficient cannot be explained clearly in terms of simple "pseudo-chemical" theory and serves to emphasize the lack of any adequate theory of metallic solutions. ***R. P. Smith.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 62-64.

7025* A Texture Study in Silicon Iron. A three-minute anneal at 800 C produced the primary recrystallization texture in 3% cold-rolled Si-Fe strip. The texture is described in terms of four (112) [$6\bar{8}1$]- and two (111) [$11\bar{2}$]-type components. Further annealing in a salt bath at 1260 C produced a special annealing texture. ***P. K. Koh and C. G. Dunn.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 65-69.

7026* Thermodynamic Properties of the System Pb-S-O to 1100°K. Five univariant equilibria in the system Pb-S-O were determined by measurement of the equilibrium pressure of SO_2 in the temperature range 800 to 1100 K. Thermochemical relations were employed to calculate three additional univariant equilibria, and to construct a consistent thermodynamic phase diagram for the system. ***H. H. Kellogg and S. K. Basu.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 70-81.

7027* Annealing of Point Defects in Cold-Worked Tungsten and the Influence of Impurities on the Kinetics. The kinetics of the "low-temperature" recovery of electrical resistivity of both pure and specially doped cold-worked W wire were studied in the temperature range between 250 and 450 C. A two-stage recovery process is found in both materials with a process change occurring at about 325 C in the undoped W and at about 375 C in the doped W. ***L. A. Neimark and R. A. Swalin.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 82-87.

7028* Composition-Temperature Behavior of the Martensitic Transformation in Beta AgCd. The characteristics of the martensitic transformations induced by cooling or mechanically deforming β' AgCd were studied. The composition dependences of the bcc $\rightleftharpoons$ orthorhombic M_s, M_f, A_s, A_f temperatures were determined. A transformation mechanism was suggested which would account for the distortion of the body-centered unit cube to produce the hexagonal and orthorhombic transformation structures. ***D. B. Masson.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 94-97.

7029* Effect of Grain Growth on the Formation of the Cube Texture in an Al-Mn Alloy. The volume fraction of the cube-texture component increased on continued annealing after recrystallization was complete and this can be correlated directly with the extent of grain growth. The effect of penultimate grain size on the volume fraction of the cube-texture component was clearly demonstrated in a quantitative manner. ***T. J. Koppenaal, M. N. Parthasarathi, and Paul A. Beck.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 98-102.

7030* Habit Plane of Hydride Precipitation in Zirconium and Zirconium-Uranium. A platelet form of zirconium hydride was found in Zr and Zr-1 wt.% U single crystals containing H in the range of 50 to 100 ppm. The habit planes for the hydride platelets in the Zr crystals were found to be $\{10\bar{1}2\}$, $\{11\bar{2}1\}$, and $\{1\bar{1}22\}$ while the habit planes in the Zr-1 wt % U crystals were $\{11\bar{2}1\}$, $\{11\bar{2}3\}$, and $\{12\bar{3}1\}$. With the exception of the $\{12\bar{3}1\}$ plane, these have been identified as the twin planes in Zr. ***F. W. Kunz and A. E. Bibb.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society,* v. 218, no. 1, Feb. 1960, p. 133-135.

7031 Detection of Zinc Diffusion Into Tin Coatings on Brass. Potential measurement can be used to detect the diffusion during flow-brightening or long storage. The small amounts of Zn detected by this means are sufficient to cause, on exposure to copious condensation of moisture, the formation of corrosion products which make soldering more difficult although they do not affect the soldering of the coating if it is stored normally. ***S. C. Britton and M. Clarke.*** *Institute of Metal Finishing, Transactions,* v. 36, pt. 6, Winter, 1959, p. 230-232.

7032 Precipitation Effects in Liquid Aluminium Alloys. An ultrasonic technique can be used to investigate the presence of oxides and precipitated phases in melts of Al alloys. Conditions and rates of precipitation and solution of these solid phases can be measured, and their concentrations in different melts can be compared. ***N. D. G. Mountford and R. Calvert.*** *Institute of Metals, Journal,* v. 88, pt. 3, Nov. 1959, p. 121-127.

7033 Clustered Vacancy Defects in Some Face-Centred Cubic Metals and Alloys. Experiments by small-angle X-ray scattering and transmission electron microscopy demonstrated conclusively the aggregation of vacancies in quenched metals. Four different types of clustered vacancy defects were observed. The conditions governing the formation of each of these defects are discussed and their practical significance mentioned. ***R. E. Smallman, K. H. Westmacott, and J. H. Coiley.*** *Institute of Metals, Journal,* v. 88, pt. 3, Nov. 1959, p. 127-133.

7034 Metallurgical Observations of Nitrides in Chromium. Electrolytic Cr flakes that were heat-treated in H containing traces of N ($<0{\cdot}001\%$) were found to be thermally etched on

one side, while the opposite side was usually covered with small, vapor-deposited, crystals of Cr. Surface markings were present on both the small crystals and the thermally etched surfaces. The markings were the result of the presence of a yellowish metallic material along the grain boundaries and within the grains. This material was isolated from the Cr and identified by means of electron- and X-ray-diffraction patterns as a mixture of the Cr nitrides, Cr_2N and CrN, the former being the predominant phase. The presence of the nitrides is explained on the basis of available thermodynamic data for the Cr-N system. ***I. S. Servi and W. D. Forgeng.*** *Institute of Metals, Journal,* v. 88, pt. 4, Dec. 1959, p. 164-167.

7035 Hydrogen-Dependent Precipitates in Titanium-Chromium Alloys. The identity of H-dependent precipitates, and the influence upon their characteristics of matrix structures resulting from decomposition of metastable β and martensitic α phases, were studied in two Ti-Cr alloys. Some effects of strain in promoting precipitation at room temperature are described. ***L. H. Keys, I. R. Lamborn, and G. C. McDonald.*** *Institute of Metals, Journal,* v. 88, pt. 4, Dec. 1959, p. 168-172.

7036 Mechanism of Age-Hardening in Magnesium-Zinc Alloys. Electron-diffraction studies show that the initial precipitate is not the equilibrium compound MgZn, but a transition precipitate indistinguishable from the hexagonal Laves phase $MgZn_2$. This transition phase also forms during the eutectoid decomposition of the phase Mg_7Zn_3. ***L. Sturkey and J. B. Clark.*** *Institute of Metals, Journal,* v. 88, pt. 4, Dec. 1959, p. 177-181.

7037 Add Columbium to Killed Steel to Retard Grain Growth. Columbium imparts a strong resistance to grain growth—even in steel killed with two lb per ton of Al; small amounts increase the yield strength of this killed, heat treating grade by as much as 8200 psi. Of the four Cb levels studied, an addition of about ⅛ lb per ton gives the best mechanical properties. However, if the steelmaker wants extra resistance to grain growth, he may obtain it by a Cb addition of about eight-nine lb per ton. ***E. E. Fletcher and A. R. Elsea.*** *Iron Age,* v. 185, no. 1, Feb. 25, 1960, p. 72-73.

7038 An Electron Diffraction Method for Determining the Crystal Lattices of Small Thin Lamellar Precipitates Occurring in Steels. A method was developed for determining the crystal lattices of individual plate-like precipitates occurring in steels. The technique is particularly valuable for determining crystal lattices of small thin particles for which X-ray diffraction methods fail. Application of the method to plate-like cementite (Fe_3C) and iron nitride (α "-$Fe_{16}N$) precipitates is described. ***G. R. Booker, J. Norbury, and A. M. Rose.*** *Iron and Steel Institute, Journal,* v. 193, pt. 3, Nov. 1959, p. 221-226.

7039 Hexagonal Carbide and Nitride Phases and Their Occurrence in Some Alloy Steels. Hexagonal carbides and nitrides which involve a close-packed arrangement of transition metal ions are described and lattice parameters are tabulated for all the known examples of such compounds. ***K. W. Andrews and H. Hughes.*** *Iron and Steel Institute, Journal,* v. 193, pt. 3, Nov. 1959, p. 304-311.

7040 Factors Affecting the Transition Temperatures of Forgings Used in Power-Generating Equipment. The principal metallurgical factors affecting transition temperature in low-alloy steels are ferrite grain size, tensile or yield strength, and susceptibility to temper embrittlement. Quantitative relationships have been derived between transition temperature and parent austenite grain size, tensile strength, and C content. These relationships, together with a knowledge of the susceptibility to temper embrittlement, have been successfully used to account for the transition temperature of material from large forgings and have indicated the lines along which efforts should be made to lower these transition temperatures. ***B. Cina and P. Jubb.*** *Iron and Steel Institute, Journal,* v. 193, pt. 4, Dec. 1959, p. 329-349.

7041 Absorption Correction in Precision Determination of Lattice Parameters. X-ray powder and rotation patterns of six cubic substances (W, Si, Cr, TiO, Al, and V) using specimens of different thickness were made; the patterns were measured, the lattice constants calculated and plotted against the θ angle or against the Nelson and Riley function. Such curves for thin mounts, semitransparent to X-rays (below 0.2 mm in dia.), consist of two parts: a region of high slope (due to absorption) and one approaching a zero slope at high Bragg angles. ***M. E. Straumanis.*** *Journal of Applied Physics,* v. 30, Dec. 1959, p. 1965-1969.

7042 Studies of Vacancies in Dislocation-Free Ge Crystals. Describes experiments whose main object was to determine the number of vacancies incorporated into a Ge crystal during growth. Possible methods for achieving equilibrium vacancy concentrations at lower temperature by extracting vacancies from large dislocation-free Ge samples. ***A. G. Tweet.*** *Journal of Applied Physics,* v. 30, Dec. 1959, p. 2002-2010.

7043* The Constitution of Manganese Base Alloys With Metals of the Second Transition Series. Binary phase diagrams were determined for Mn base alloys with the metals Y, Zr, Nb, Mo, Ru, Rh, Pd and Ag. The results are based principally on thermal analysis, supplemented by microscopical examination. ***A. Hellawell.*** *Jounral of the Less-Common Metals,* v. 1, no. 5, Oct. 1959, p. 343-347.

7044* The Ordered Crystal Structure of In_2Te_3. The intermetallic semiconducting compound In_2Te_3 is based on a defect Zn-blende (or fluorite) structure, and it is possible to cause ordering of the lattice vacancies. Experimental work was carried out to investigate the methods by which specimens in this ordered state may be produced, and the ordering temperature briefly investigated. ***P. J. Holmes.*** *Journal of the Less-Common Metals,* v. 1, no. 5, Oct. 1959, p. 362-376.

7045* A Survey of the Rhenium-Carbon System. Alloys of Re and C form a simple eutectic system at 16.9 at.% C, 2480 C. The solid solubility of C in Re is 11.7 at.% at the eutectic temperature, falling to 4.2 at.% at 1800 C. No rhenium carbide was detected in the system. ***J. E. Hughes.*** *Journal of the Less-Common Metals,* v. 1, no. 5, Oct. 1959, p. 377-381.

7046* Ordering in CoPt—FePt Alloys. Six alloys having equal increments of composition were investigated, and the lattice parameter values for both the ordered and disordered states were determined for all alloys except FePt itself where the disordered state could not be obtained. X-ray techniques were used to estimate the ordering temperatures, and then the type of ordering reaction (continuous or discontinuous) occuring at various temperatures was investigated. ***J. C. Woolley and B. Bates.*** *Journal of the Less-Common Metals,* v. 1, no. 5, Oct. 1959, p. 382-389.

7047 Dislocation Etch Pits in Zinc Crystals. Star-shaped terraced etch pits at the sites of dislocations were produced on the (0001) plane of crystals of vapor grown Zn using Superoxol etch. The same etch pattern is also observed on the (0001) basal facets of crystals grown by the droplet method. Closely spaced etch pits suggestive of low-angle tilt boundaries were also observed. ***Joy George.*** *Philosophical Magazine,* v. 4, ser. 8, Oct. 1959, p. 1142-1144.

7048 Soft X-Ray Emission Spectra From Lithium and Lithium-Magnesium Alloys. In the alloys electron transfer takes place from Mg to Li. The shape of the high-energy edge of the LiK emission spectrum could be explained by broadening of the ls ionic level in the crystal. ***J. A. Catterall and J. Trotter.*** *Philosophical Magazine,* v. 4, ser. 8, Oct. 1959, p. 1164-1170.

7049 The Effect of Quenching on the Formation of G.P. Zones and θ' in Al Cu-Alloys. The rate of formation of G.P. zones decreases not only on slower quenching but also on lowering the reversion treatment temperature. The addition of a trace of indium (Cd, Sn) is known to decrease the rate of zone formation which is then negligible except after very fast quenching. The rate of formation of the metastable precipitate θ' is dependent on dislocations present in the alloy rather than an excess mobile vacancy concentration. Traces of In (or Cd) form even more efficient nuclei for θ' than dislocations but the effect of the In (or Cd) is destroyed by fast quenching or cold work. ***J. M. Silcock.*** *Philosophical Magazine,* v. 4, ser. 8, Oct. 1959, p. 1187-1194.

7050 Permeation of Hydrogen Through Metals. The theory of permeation of H through certain transition metals was further developed. It is shown that this theory, in which certain slow phase-boundary processes couple with diffusion to produce the permeation phenomena, can in rather simple ways

predict the observed behavior. ***R. Ash and R. M. Barrer.*** *Philosophical Magazine*, v. 4, ser. 8, Nov. 1959, p. 1197-1206.

7051 Quenching Defects in Binary Aluminium Alloys. Thin foils of binary Al alloys containing various amounts of Cu, Ag, Zn, and Mg in solid solution were prepared from quenched specimens and examined by transmission electron microscopy. In all the alloys, closed loops of dislocation lines and complex dislocation networks were observed. Dislocations and grain boundaries are shown to be sinks for vacancies and the possibility that these defects are also collectors for solute atoms is discussed. Helical dislocations were observed in quenched alloys only when the quenching temperature was close to the limit of solid solubility. ***G. Thomas.*** *Philosophical Magazine*, v. 4, ser. 8, Nov. 1959, p. 1213-1228.

7052 Twinning in Cadmium Dendrites. Growth twins of Cd with a $[1\bar{2}30]$ twin axis and a (0001) composition plane are formed during deposition from the vapor at high supersaturation. The twin crystals grow in the form of flat "leaf" dendrites several mm long and only a few microns in thickness, while other crystals in the deposit are three-dimensional, nondendritic, and limited in size to a few microns. The experimental conditions under which leaf dendrites appear are given, the morphology of the dendrites and the arrangement of atoms near the composition plane are described, and a connection between twinning and the dendritic growth of Cd is proposed. ***H. H. Wills.*** *Philosophical Magazine*, v. 4, ser. 8, Nov. 1959, p. 1229-1241.

7053 Accurate Determination of the Lattice Parameters of Beryllium. The lattice parameters of a single crystal of Be were determined from observations on a divergent-beam transmission X-ray photograph of the crystal. Diffraction in the crystal leads to a pattern of deficiency lines on a photographic plate, the geometry of which is determined by the lattice parameters of the crystal and the wavelength of the radiation, but is independent of the exact experimental arrangement. ***D. R. Schwarzenberger.*** *Philosophical Magazine*, v. 4, ser. 8, Nov. 1959, p. 1242-1246.

7054 Interaction of Dislocations With an Applied Stress in Anisotropic Crystals. The equilibrium shape of a dislocation segment between two pinning points in the same glide plane was calculated. The assumption was made that the dependence of the dislocation self-energy on the geometry of the dislocation line can be expressed by using an energy per unit length, E, which is a function only of the angle, θ, between the Burgers vector and the tangent to the dislocation. Only glide of the dislocation, not climb, is considered. The results obtained were compared with those for elastically isotropic crystals. ***G. DeWit and J. S. Koehler.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1113-1120.

7055 Influence of Elastic Anisotropy on the Dislocation Contribution to the Elastic Constants. Calculations of the dislocation contribution to the measured elastic constants of face-centered cubic crystals were as follows. First, the displacement of a pinned dislocation segment under an externally applied stress was evaluated. Then the contribution to the resulting macroscopic distortion of the specimen resulting from the motion of all the dislocations present was calculated. The results are that the contributions for given dislocation arrangements increase with increasing anisotropy. For Cu and Pb the contributions amounted to a few percent in a pure well annealed crystal and can be as large as 10% in slightly deformed crystals. Edge dislocations were found to make about ten times larger contributions than a similar density of screw dislocations. ***J. S. Koehler and G. DeWit.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1121-1125.

See also: **6965** (recrystallization of Al); **6989** (structure of Cr-Ni steels); **6990** (structure of Cr-Ni steels).

METALS—POWDER

7056* Some Properties and Metallography of Steel-Bonded Titanium Carbide. Composite materials consisting of alloy steels and up to 54 wt.% (65 vol.%) of Ti carbide are described. They are made by conventional powder-metallurgical techniques involving liquid-phase sintering. Unlike most cermets, these composite materials are capable of being annealed and hardened in a manner similar to alloy steels. In the annealed condition, they can be machined; in the hardened condition, their properties approach those of cemented tungsten carbide. ***Martin Epner and Eric Gregory.*** *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 1, Feb. 1960, p. 117-121.

7057 Iron Powder Produced by the H-Iron Process. The iron powder plant is comprised of four interrelated sections: iron ores are prepared for reduction; H, the reducing agent, is processed from coke oven gas and O in the H production unit; the ore and H are chemically reacted in the H-Fe reduction section to produce metallic Fe; the Fe is then further processed in the finishing plant. ***George G. Karian.*** *Blast Furnace and Steel Plant*, v. 48, Mar. 1960, p. 276-281.

7058 Chromium Carbide as a Basis for Hard Metals Having Special Properties. Properties of known chromium carbides and how they compare with properties of other metal carbides. Production of Cr_3C_2. Structure of unbonded and nickel-bonded chromium carbide. Mechanical properties of Cr_3C_2; corrosion resistance; oxidation resistance compared with that of stainless steel at 950 C. ***V. V. Grigor'eva, V. N. Klimenko, and T. Ia. Kosolapova.*** *Henry Brutcher Translation No.* 4706, 16 pp. (From *Problems of Powder Metallurgy and Strength of Materials*, 1958, p. 79-89. Published by the Ukrainian Academy of Sciences, Kiev.) Henry Brutcher, Altadena, Calif.

7059 Production of Thorium Powder by Calcium Reduction of Thorium Oxide. Calcined ThO_2 was reduced in an inert atmosphere at 950 C with high-purity Ca metal in the presence of $CaCl_2$. The Th powder so produced has essentially the same purity as the ThO_2 starting material. Important factors controlling yield and quality of the Th powder are discussed. ***N. Fuhrman, R. B. Holden, and C. I. Whitman.*** *Electrochemical Society, Journal*, v. 107, Feb. 1960, p. 127-131.

7060* The Effect of Oxygen Content on Properties of Sintered Metals and the Contact Zone Formed Between Them. Compacts of Cu and W powder and Fe and W powder respectively, were produced in such a way that one half of the compact was W powder and the other half was the other powder. The compacts, with various amounts of oxides of the components added, were sintered. Hardness in the contact zone, electrical conductivity in the neighborhood of the contact zone, tensile strength of the test samples, microstructure, and density of both parts of the samples were investigated. *(In German.)* Über den Einfluss des Sauerstoffgehaltes auf die Eigenschaften von Sintermetallen und die zwischen ihnen gebildete Kontaktzone. ***Wladislaw Rutkowski.*** *Zeitschrift für Metallkunde*, v. 51, Jan. 1960, p. 59-61.

7061* Investigations of the Underlying Principles of Sintering of Metal Powders, With Allowance for the Effect of Superficial Oxide Layers. The shrinking of Cu and Fe powder compacts in the direction of compacting as effected by sinter temperature and sinter time are graphically recorded. The graphs may approximately be represented in specific time intervals by exponential functions; the activation energy is determined. The most probable mechanism of the early stages of sintering appears to be plastic flow; and for the later stages, grainboundary diffusion. *(In German.)* Untersuchungen über die Grundlagen des Sintervorganges in Metallpulvern unter Berücksichtigung des Einflusses oberflächlicher Oxydschichten. ***Wolfgang Dienst and Otto Werner.*** *Zeitschrift für Metallkunde*, v. 51, Jan. 1960, p. 45-52.

NONDESTRUCTIVE TESTING AND QUALITY CONTROL

7062 Practical Planning for Non-Destructive Testing by Use of Radiation. The problems discussed are: choice of source or unit, exposure room design, protective materials,

fixed and portable sources, and employee considerations. The three testing units described are the 250 kv X-ray, the 1000 or 2000 kv X-ray and the betatron. ***F. S. Sutherland.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 25-29. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

7063 Radiography, Microstructure and Mechanical Properties of Cast Magnesium—Thorium—Zirconium Alloy HK 31A. A Correlation. Autoradiographs, radiographs, micrographs and spectographs were made of the tested specimens to investigate variations in composition and associated effects. X-ray indications were caused by segregation, the segregation had a definite effect on the microstructure. ***T. R. Bergstrom and R. G. Bassett.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 217-225. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

7064 Ultrasonic Attenuation in Cast Aluminum. Aluminum test plates (7% Si–0.3% Mg) were cast with a chill on one edge and a riser at the opposite edge. Radiographic examination was not sensitive to the change of properties. Ultrasonic attenuation measurements were made at various locations in the plates. The attenuation characteristics are markedly affected by the presence of gas and microshrinkage in the samples. ***H. Smolen and H. Rosenthal.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 257-262. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

7065* Questions of Guarantee With Nuclear Fuels in Ship Reactors. A guarantee for the behavior of fuel elements in power reactors eludes commercial calculations on account of the difficulty of clearing up the question of faults in irradiated elements with high costs of testing. By the imposition of appropriate testing processes, the properties of fuel elements can be unequivocally tested before introduction into the reactor so that clear acceptance conditions are created. *(In German.)* Garantiefragen bei Kernbrennstoffen in Schiffsreaktoren. ***Heimo Hardung-Hardung.*** *Atomwirtschaft*, v. 5, no. 1, Jan. 1960, p. 14-16.

7066 The Use of Radioisotopes in a Blast Furnace. Co^{60} was placed in six locations in a pneumatically-applied castable throat patch of the furnace to enable the operators to determine the life of the patch. ***A. Eugene Frey.*** *Blast Furnace and Steel Plant*, v. 48, Feb. 1960, p. 165-168.

7067 Nondestructive Testing in the Steel Industry. There are four general types of nondestructive testing: ultrasonic penetrant and magnetic particle, radiation, eddy current, and magnetic induction. Radiography is the only test that can be reliably applied to establish the soundness of cast products. Ultrasonics can be used by resonance, through-transmission, and pulse-echo. The resonance method is used for gaging thickness of sheet and plate. The pulse-echo method is used on large sheet sections. ***James B. Austin.*** *Blast Furnace and Steel Plant*, v. 48, Feb. 1960, p. 174-178.

7068 Measurement of Tinplate Thickness Using Fluorescent X-Rays Excited by a Radioactive Source. Using tritium bremsstrahlung as an X-ray source and a thin-windowed scintillation counter as a detector, a method of measuring the thickness of tinplated steel over the range 0-1.55 microns (1.00 lb per basis box) has been developed. The technique depends on absorption of the Fe fluorescent X-radiation by the tin layer. An accuracy of 1% can be obtained with 95% confidence in a counting time of 30 seconds. ***J. F. Cameron and J. R. Rhodes.*** *British Journal of Applied Physics*, v. 11, Jan. 1960, p. 49-52.

7069* Thermographic Test Detects Flaws in Honeycomb. Prototype automatic equipment accurately controls speed at which honeycomb section is processed. Bondcheck fluid is applied by spraying under controlled pressure and movement. After application of fluid, conveyor moves specimen under infrared lamps for controlled heating. Specimen may then be inspected directly or may be photographed for record purposes. *Design News*, v. 15, Feb. 29, 1960, p. 4.

7070 Quality Control in Bearing Manufacture and Vibration Measurement. Among the important quality factors to be controlled in the production of instrument bearings is vibration. Here is a survey of available techniques for measurement of bearing vibration and a state-of-the-art review of the quality-control standards of bearing manufacturers. ***M. H. Aronson.*** *Instruments and Control Systems*, v. 33, Feb. 1960, p. 260-264.

7071* Application of Electron Microscopy. A Simple Extraction Replica for the Study of Fine Grain Phases. A method of preparing specimens which allows the disclosure of precipitates by means of a simple extraction replica is described, and examples are given of its use. The work was reported in Hutnické Listy, 1958, and the English version given here is the tenth of a series illustrating the use of the electron microscope in metallurgy. The author is at the Research Institute for Materials and Technology, Prague. ***Jaroslav Jazek.*** *Metal Treatment and Drop Forging*, v. 27, Jan. 1960, p. 19-27.

7072* Ultrasonic Liquid-Level Gauging. Gage construction and operations. Continuous and intermittent operations. ***David E. Gross.*** *Missile Design & Development*, v. 7, Feb. 1960, p. 30-33.

NUCLEAR PHYSICS, NUCLEONICS, AND RADIATION

7073 Accelerators of Ions and Electrons. Vacuum problems in accelerators, electrostatic linear and high-frequency linear accelerators, induction accelerators (betatrons), high-frequency circular accelerators, and the electron cyclotron are discussed. ***Čestmír Simánë.*** 191 pp. 1959. Artia Prague, Czechoslovakia. (QC786 Si42utr)

7074 Threshold Effects in Nuclear Reactions. Explores the idea that between the colliding particles or the reaction products of a nuclear reaction the interaction in the immediate neighborhood of the nuclear surface may be represented by a static attractive potential. The Wigner-Eisenbud theory of nuclear reactions is readily reformulated to take this "surface potential" into account, whereupon quasi-bound states of the compound system are found to appear, with high probability, very close to the various thresholds for two-particle channels. Consequently, the cross section of a reaction close to any threshold should have a certain resonance-like behavior. The relevant experimental data are reviewed and are found to support all the predictions of the theory. ***A. I. Baz.*** *Advances in Physics*, v. 8, no. 32, Oct. 1959, p. 349-374.

7075* Aims—and Results—of Nuclear Reactor Research in Britain. The Britain reactors, foreseen for operation in new power stations are described as gas-cooled and graphite-moderated. Two new reactors will be built of a low-energy version. ***T. A. Hall.*** *American Engineer*, v. 31, Mar. 1960, p. 39-40.

7076* Influence of Temperature on Reactor Dynamics. II. The reactor temperature influences the chain reaction mainly through density changes consequent upon thermal expansion and through changes in the relative velocities of neutrons and atomic nuclei. The variation with time of the temperature and the influence of temperature on reactor performance are investigated with the aid of a thermal-flow diagram for which an electrical-circuit diagram was substituted in order to simplify the equations. *(In German.)* Einfluss der Temperatur auf die Reaktordynamik. II. ***G. Kourim.*** *Atomwirtschaft*, v. 5, no. 1, Jan. 1960, p. 22-27.

7077* Possibility of Manifesting the Phase Coherence in the Resonance Diffusion of the γ-Rays by Means of Atomic Nuclei. When the resonance diffusion of the γ-rays by means of the atomic nuclei of a crystal lattice occurs without any recession of the nucleus, the coherence of the diffused radiations must be shown by a distribution of intensity similar to that of the diffraction of X-rays by the electrons of a crystal. *(In French.)* Sur la possibilité de mettre en évidence la cohérence de phase dans la diffusion de résonance des rayons γ par des noyaux atomiques. ***Alfred Kastler.*** *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, v. 250, no. 3, Jan. 18, 1960, p. 509-511.

7078* Measuring the Spin-Medium Relaxation Time T_1 of the ^{63}Cu as a Function of Temperature. In order to perform measurements of the spin-lattice relaxation T_1 of metals, a spin-echo device was built. The preciseness of the measure-

ments as a function of the precautions taken is discussed and the first results of the study of the ^{64}Cu as a function of temperature are given. *(In French.)* Mesure du temps de relaxation spin-milieu T_1 du ^{64}Cu en fonction de la température. ***Bernard Carcenac de Torne.*** *Comptes Rendus Hebdomadaires des Seances de l'Académie des Sciences,* v. 250, no. 3, Jan. 18, 1960, p. 512-514.

7079 The Suitability of Various Gases as Working Media for a Nuclear Reactor-Gas Turbine Combination. Various gases were examined with regard to their possible utilization as coolants and working media in a closed circuit comprising a nuclear reactor and a gas turbine. ***W. Pflaum and D. Reiher.*** *Engineers' Digest,* v. 21, Feb. 1960, p. 94 + 2 pages. (Translated from *MTZ,* Germany, v. 21, no. 1, Jan. 1960, p. 20-22.)

7080 Effects of Reactor Exposure on Boron-Lined and BF_3 Proportional Counters. The results of reactor exposure on the characteristics of several types of B-lined and BF_3-filled proportional counters are presented, and the important design and application criteria that lead to improved performance of counters after long reactor exposure are discussed. ***William M. Trenholme.*** *IRE Transactions on Nuclear Science,* v. NS-6, no. 4, Dec. 1959, p. 1-7. (TK1 In6.6ns Vis.)

7081 The Describing Function of Nuclear Reactors. It is found that a reactor can be represented by means of a linear system and a nonlinear system in cascade. The transfer function of the linear system is the classical low-power transfer function. The nonlinear system is a nonlinear amplifier with an exponential characteristic. ***Henri B. Smets.*** *IRE Transactions on Nuclear Science,* v. NS-6, no. 4, Dec. 1959, p. 8-12. (TK1 In6.6ns Vis.)

7082 The Separation of Uranium Isotopes. All available information on U isotopic separation, from public papers, private communications and direct tests and studies, are collected. In view of the fact that the characteristic and essential feature of the gaseous diffusion process—the only one presently applied to industrial production—is the preparation of suitable porous barriers and that to this processing only the greatest part of the research made in Italy has been devoted, this subject has been treated rather diffusely. Other topics have been dealt with mainly to obtain an evaluation of the various elements which determine the convenience of building a plant. *(In Italian.)* Separazione degli isotopi dell'uranio. ***P. Caldirola and R. Fiocchi.*** *Italy, Comitato Nazionale per le Ricerche Nucleari, CNI-24,* Sept. 1959, 165 pp. (QC770 Itl.2ci Contin.)

7083* Low Energy Electron Spectra of Active Depositions of Thoron and Radon. I. Energies and Intensities of Bands of Auger L Electrons. The modern theoretical and experimental results concerning the energies and intensities of the bands of Auger L electrons of the heavy atoms (Z 81-84) were presented in view of the further interpretation of the low energy electron spectra of the atoms of active thoron and Rn depositions. *(In French.)* Les spectres d'électrons de faible énergie des dépôts actifs du thoron et du radon. I. Énergies et intensités des raies d'électrons Auger L. ***José Sant'ana Dionisio.*** *Journal des Recherches du Centre National de la Recherche Scientifique,* no. 48, Sept. 1959, p. 231-275.

7084 Atomic Progress. Neutron Irradiation Damage. I. All materials in the core of a nuclear reactor are bombarded by neutrons. These neutrons produce damage in reactor materials in two ways; directly, by knocking atoms out of place, and indirectly, by producing changes in atomic nuclei that cause radiation damage. Outlines some of the theoretical aspects of this subject. *Metal Industry,* v. 96, Jan. 15, 1960, p. 45 + 1 page.

7085 Safety Principles for Low Power Research Reactor. The hazards involved in the operation of small low-powered research reactors are small, and that the system should be capable of being operated in complete safety providing attention is paid to certain basic principles. Of these, the most important relate to the need to restrict the excess reactivity to an eversafe amount. ***B. E. Elthan and E. P. Hicks.*** *Nuclear Engineering,* v. 5, Mar. 1960, p. 96-98.

7086 Research Reactors. A Survey of Current Designs. I. Babcock open pool 1-5 MW, Indatom's pool reactors, Atomics International solution-type, General Atomic's Trigas, Foster Wheeler tank type, the Argonaut family, Aerojet-General range, NDA 10kW D_2O-type, Allis-Chalmers high flux reactors are discussed. *Nuclear Engineering,* v. 5, Mar. 1960, p. 99-104.

7087 A Vector Diagram for Reactor Channel Temperatures. The axial distribution of heat generation in a cylindrical core with vertical coolant channels is approximately sinusoidal. Temperatures can be plotted by means of a simple vector diagram, the construction of which is shown in the article. ***P. R. J. French.*** *Nuclear Engineering,* v. 5, Mar. 1960, p. 120-122.

7088* The Oak Ridge Relativistic Isochronous Cyclotron. II. Magnetic Field Design for the Isochronous Cyclotron. The model magnet work and design studies which resulted in the selection of a three-sector azimuthally varying magnetic field with weak spiral are described. A foursector, tight-spiral field was also considered. ***B. L. Cohen, et al.*** *Nuclear Instruments and Methods,* v. 6, Jan. 1960, p. 105-125.

7089* The Disintegration of Nitrogen by Fast Neutrons. The disintegration of N by fast neutrons has been studied, using a grid-type ionization chamber filled with N or a N-Ar mixture. Monoenergetic neutrons for studying the reactions from a neutron energy of 1.3 to 8.2 MeV were produced by the $T^3(p,n)He^3$ and $D(d,n)He^3$ reactions. One group of protons, three α particle groups, and a group of tritons were observed as disintegration products of the neutron reactions in N. The $N^{14}(n,p)C^{14}$ reaction leaving C^{14} in its ground state was studied from 1.3 to 4.3 MeV, and the maximum cross section observed was 230 mb. ***Fletcher Gabbard, H. Bichsel, and T. W. Bonner.*** *Nuclear Physics,* v. 14, no. 2, Dec. 1959, p. 277-294.

7090* Gamma Radiations From Inelastic Scattering of Fast Neutrons in C^{12}, N^{14}, and O^{16}. Measurements have been made of the cross section for the production of 4.43-MeV γ-radiation by the inelastic scattering of neutrons by C^{12}. The experiments have been carried out, using monoenergetic neutrons with energies of from 4.6 to 9.8 MeV. Ten resonances were observed in this energy range, and the maximum cross section of 45 mb/sr was obtained at a neutron-energy of 8.1 MeV. Measurements made with an O^{16} scatterer also showed many resonances for the production of γ-radiation with energies of 6.14, 6.91, and 7.12 MeV. The maximum cross section for γ-emission was obtained with 9.1-MeV neutrons and amounted to 30 mb/sr. ***H. E. Hall and T. W. Bonner.*** *Nuclear Physics,* v. 14, no. 2, Dec. 1959, p. 295-313.

7091* Antisymmetrization of "Cluster Model" Wave Functions and Their Expansion in "Shell Model" Wave Functions. A method is described whereby oscillator "Cluster Model" wave functions may be antisymmetrized and expressed as a superposition of "Shell Model" wave functions. ***Th. Kanellopoulos and K. Wildermuth.*** *Nuclear Physics,* v. 14, no. 3, Jan. 1960, p. 349-375.

7092* Application of the Collective Model to Some Nuclei in the d-Shell. Eigenvalues and eigenfunctions have been recalculated for the Nilsson deformed potential well with the addition of a term μl^2. Comparison of the results with the decay schemes of nuclei in the d-shell shows that some of the existing discrepancies are removed by the presence of this correction. ***G. R. Bishop.*** *Nuclear Physics,* v. 14, no. 3, Jan. 1960, p. 376-388.

7093* Role of Spin-Orbit Force in Nuclear Interactions. It is found that in order to fit the data, particularly the magnetic moment, the strength of the spin-orbit force must be comparable to that of the tensor force. ***A. N. Mitra and V. L. Narasimham.*** *Nuclear Physics,* v. 14, no. 3, Jan. 1960, p. 407-428.

7094* Properties of Levels Excited in (p, α) Reactions on O^{18}, P^{31}, Cl^{35}, Cl^{37}, K^{39} and K^{41}. Excitation functions and differential cross sections at 90° to the beam have been measured for the (p, α) ground state reactions in O^{18}, P^{31}, Cl^{35}, Cl^{37}, K^{39}, and K^{41} from 1 to 3 MeV proton energy using a magnetic spectrometer to detect the alpha particles. Reduced widths and strength functions for protons and alpha particles are derived. ***R. L. Clarke, E. Almqvist, and E. B. Paul.*** *Nuclear Physics,* v. 14, no. 3, Jan. 1960, p. 472-497.

7095* Mechanism of Interaction of Fast Protons With Nucleons and Nuclei. Angular and energy characteristics of interaction between 9 GeV protons and emulsion nuclei, as

well as the production of strange particles were investigated. The obtained experimental results reveal a better agreement with the cascade mechanism of nucleon-nucleus interaction than with the nucleon-tube model. The size of a nucleon core is discussed. ***V. S. Barashenkov, et al.*** *Nuclear Physics*, v. 14, no. 3, Jan. 1960, p. 522-539.

7096* The Disintegration of La^{181}. The decay of La^{181} was studied with the help of a magnetic lens spectrometer, scintillation spectrometers and scintillation coincidence spectrometers. A disintegration scheme is proposed. ***Charles B. Creager, C. W. Kocher, and Allan C. G. Mitchell.*** *Nuclear Physics*, v. 14, no. 4, Jan. 1960, p. 578-588.

7097* A Search for Parity Mixtures in Nuclear States. The γ radiation emitted from nuclear states which are polarized by β decay can show a 90 degree asymmetry if parity conservation in nuclear states does not hold strictly. The measurement are performed with the β-γ decays of $A^{41} \rightarrow K^{41}$, $Xe^{133} \rightarrow Cs^{133}$, and $Lu^{177} \rightarrow Hf^{177}$. ***F. Boehm and U. Hauser.*** *Nuclear Physics*, v. 14, no. 4, Jan. 1960, p. 615-625.

7098* The Angular Distribution of β Particles. A general formula is given for the angular distribution and polarization of electrons emitted in β decay from oriented nuclei. The formula in a form convenient for switching it into the general formalism of angular correlations so as to get β–γ correlations. ***G. Rakavy.*** *Nuclear Physics*, v. 14, no. 4, Jan. 1960, p. 661-681.

7099* Shielding Design—Theory and Practice. ***K. T. Spinney.*** *Nuclear Power*, v. 5, Feb. 1960, p. 134-137.

7100* Reactivity Effects of Large Voids in the Reflector of a Light-Water-Moderated and -Reflected Reactor. Reactivity effects of large voids in the reflector of the Pool Critical Assembly, an enriched-uranium, light-water-moderated and -reflected reactor, were investigated. The four reactivity effects studied were (1) variation of reactivity with void size, (2) variation of reactivity with void position on the core-reflector interface, (3) variation of reactivity with the distance between the void and the core, and (4) superposition of void reactivity effects. ***A. B. Reynolds et al.*** *Nuclear Science and Engineering*, v. 7, Jan. 1960, p. 1-13.

7101* Enriched-Uranium Hydride Critical Assemblies. Critical assemblies reported here consist of approximate spheres of enriched-U hydride composition (approximating UH_3) in 8-in. thick normal U and Ni reflectors and in a U reflector with Ni liner. Data are of the following types: (1) critical sizes, (2) values of Rossi α in the neighborhood of delayed critical, (3) activation rates of various internal neutron detectors, and (4) reactivity coefficients of a variety of elements. ***G. A. Linenberger, J. D. Orndoff, and H. C. Paxton.*** *Nuclear Science and Engineering*, v. 7, Jan. 1960, p. 44-57.

7102* An Approximate Method for Treating Neutron Slowing Down. The slowing down density, q, of neutrons in a reactor may be decomposed into a sum of parts due to various nuclear species $q = q^1 + q^2 + \ldots$ having corresponding scattering cross sections $\mu_{s1}, \mu_{s2}, \ldots$ An approximate relation between qi and isotropic flux $\phi(u)$ (where u is the lethargy) is proposed. $\gamma_1 \frac{\delta q^1}{\delta u} + q_1 = \xi \mu s i \phi$. The values of γi and xi are derived and interpreted. ***Gerald Goertzel and Eugene Greuling.*** *Nuclear Science and Engineering*, v. 7, Jan. 1960, p. 69-72.

7103 Accuracy of the S_n Code in Cell Calculations. The neutron balance of a reactor system is probably the most important single quantity to be obtained from an analysis of static core physics. In a heterogeneous reactor configuration, an accurate knowledge of the different reaction rates must be obtained by first studying the unit cell. The results for the unit cell are used in the homogenization of the reactor lattice so that a multigroup, multiregion reactor program may be used to investigate the reactions rates of the reactor system. A study was made of the ability of the S_n form of the neutron Transport Equation to describe accurately the thermal neutron flux distribution in a unit cell. Excellent agreement was obtained for the S_n calculations. ***A. V. Campise.*** *Nuclear Science and Engineering*, v. 7, Feb. 1960, p. 104-110.

7104 Irradiation of Uranium Monocarbide. Uranium carbide containing about 5.2 w/o C has been irradiated to nominal burnups of 1000 and 5000 Mwd/ton of carbide. The results are generally encouraging, although some cracking has been observed. The observed density decreases were about the same at 1000 and 5000 Mwd/ton irradiations, being 0.7 to 2.5 and 0.6 to 2.5% respectively. The problems and questions raised by these irradiations are discussed. ***F. A. Rough, A. W. Hare, R. B. Price, and S. Alfant.*** *Nuclear Science and Engineering*, v. 7, Feb. 1960, p. 111-121.

7105 A Wide-Range Neutron Detector and Monitoring Instrument. A boron-lined proportional counter has been developed whose cathode diameter varies continuously, hence varying the gas multiplication along the length of the counter. The sensitive area of the cathode thus becomes a function of the applied voltage, electrical amplification, and pulseheight discrimination. A semi-empirical relationship between counter geometry, gas parameters, and applied voltage is used to develop theoretical expressions for the dependence of count rate on applied voltage and cathode geometry. ***Karl G. A. Porges and Thomas E. Klippert.*** *Nuclear Science and Engineering*, v. 7, Feb. 1960, p. 147-155.

7106 High-Frequency Limit of Bremsstrahlung in the Sauter Approximation. The expansion in powers of $Z/137$ utilized in the Sauter theory of the photoelectric effect yields a nonzero cross section proportional to Z^3 at the high-frequency limit of the bremsstrahlung spectrum, and also at the low electron energy limit of the pair production spectrum. These cross sections are related to the Sauter photoelectric cross section by detailed balancing. The results apply equally when the effects of spin orientations and X-ray polarization are considered. ***U. Fano.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1156-1158.

7107 Bremsstrahlung and the Photoelectric Effect as Inverse Processes. The bremsstrahlung matrix element at the short-wavelength limit of the spectrum is calculated to lowest order in $\alpha = Z/137$, for an unscreened Coulomb field. The result, valid for relativistic incoming electrons, is shown to be exactly $\alpha^{-1}m^{-\frac{1}{2}}$ times the complex conjugate of Sauter's relativistic matrix element for the K-shell photoelectric effect. ***Kirk W. McVoy and U. Fano.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1168-1184.

7108 Scattering of 18-Mev Alpha Particles by C^{12}, O^{16}, and S^{32}. The scattering of 18-Mev alpha particles by gaseous C_2H_2, O_2, and H_2S targets was studied with a multiplate scattering chamber. The elastic angular distributions exhibit the diffraction-like pattern typical of light elements. Carbon and O show a sharp rise above the Rutherford cross sections at the backward angles, with values σ/σ_R of 660 for C and 350 for O near 173°. ***J. C. Corelli, E. Bleuler, and D. J. Tendam.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1184-1193.

7109 Three-Body Breakup; Deuteron Dissociation Cross Sections. An analysis of the reaction $X(d,np)$ has been carried out within the framework of the algebraic theory of scattering. It is possible to cast the transition matrix, element governing the process into several forms. Calculations of the neutron spectrum, at 0° in center of mass, for 6.3-Mev deuterons on deuterons are presented. It is concluded that the theory as presented is capable of describing the dissociation reaction. ***James E. Young.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1201-1211.

7110 Multiple Meson Production in Nucleon-Nucleon Interactions at Energies of 10^{12} ev. A nuclear interaction of type $0 + 20p$ observed in nuclear emulsion was analyzed by measuring the energies and angles of the secondary particles. The primary energy, as determined from the angular distribution of the tracks, is 2.7×10^{12} ev. This value is in agreement with an independent estimate obtained from the total energy dissipated. A secondary collision of type $0 + 20n$ was also analyzed in the same way. Its energy is 1.4×10^{12} ev, which is comparable to the primary energy. ***Marcel Schein, D. M. Haskin, E. Lohrmann, and M. W. Teucher.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1238-1247.

7111 Interaction of Static Nucleons. The Heitler-London method has been applied to the calculation of the energy of interaction of two nucleons, as given by the fixed-source model. Numerical results are also given for the normalization of the

state vector and the number of mesons in the cloud, for the states which comprise the deuteron. The relation of the Tamm-Dancoff method is also shown and discussed in detail. ***R. E. Cutkosky.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1272-1284.

7112 Nuclear Reactions in Stars. IV. Buildup From Carbon. The nuclear reactions and resulting nucleogenesis are now studied for a gas consisting of C^{12},O^{16}, and Ne^{20} at 6 x 10^8 to 10 x 10^8 K and densities around 10^4 g/cc. The C^{12} is destroyed by compound nucleus formation from C + C collisions in about 10^6 and one years, respectively, at 6 x 10^8 and 8.5 x 10^8 K. The net result is the production of some additional amounts of O^{16} and Ne^{20}. ***H. Reeves and E. E. Salpeter.*** *Physical Review*, v. 116, 2nd ser., no. 6, Dec. 15, 1959, p. 1505-1516.

7113 Resonance Fission Widths of U^{235} for Levels From 6 ev to 50 ev. The energy variation of the total and fission cross sections of U^{235} has been measured with the Nevis synchrocyclotron neutron velocity spectrometer. Fission widths for most of the levels up to 50 ev have been deduced from these measurements. The distribution of the 38 known fission widths shows that the number of channels available for the fission process is between one and four, and is most probably two. ***W. W. Havens, Jr., E. Melkonian, L. J. Rainwater, and J. L. Rosen.*** *Physical Review*, v. 116, 2nd ser., no. 6, Dec. 15, 1959, p. 1538-1543.

7114* Electromagnetic Structure of the Nucleon. III. Static Limits and S-Wave Effects. The static limits of the 3π-state contribution (lowest order) to the electromagnetic structure of the nucleon are explicitly calculated. By comparing these with Bosco and Alfaro's results, the S-wave effect on the isoscalar part is investigated in detail, and it is shown that the S-wave effect is quite small (always less than 20%). ***Kichiro Hiida and Noboru Nakanishi.*** *Progress of Theoretical Physics*, v. 22, no. 6, Dec. 1959, p. 863-881.

7115* Reactor Fuel Processing. Problems of commercial aspects of fuel processing, of preparation for fuel processing, of research and development on fuel processing, of waste disposal and of production of U, Th, Pu, and their compounds are discussed. *Reactor Fuel Processing*, v. 3, no. 1, Jan. 1960, 57 pp.

7116 Analysis of Fuel Element Core Blanks for Argonne Low Power Reactor by Gamma Counting. The technique described was used to determine the U^{235} content of Argonne Low Power Reactor core blanks. The U^{235} content could be determined to ± 0.1 gram in core blanks which had a U^{235} content of approximately 40 grams. ***W. J. McGonnagle and R. B. Perry.*** *U. S. Atomic Energy Commission, ANL-5944*, Dec. 1959, 16 pp. (UF767 In3.lan Contin.)

7117 High-Temperature Irradiation of a Zirconium Hydride-2 w/o Uranium Alloy. Enriched $ZrH_{1.65}$-2w/o U specimens were irradiated under 1 atm of H at center-line temperatures between 900 to 1400 F to U burnups of between 13 and 25 a/o. Specially designed irradiation capsules were used to provide the conditions of temperature and H atmosphere which were required. Each capsule was instrumented with five thermocouples so that ample temperature data could be obtained during the irradiation. Almost negligible density changes were produced in the material by the irradiation. Changes in length and diameter were of a degree which could fall within experimental error in measurement. Metallographic examination showed no change in microstructure which could be attributed to the effect of irradiation. ***Gerald E. Lamale, et al.*** *U. S. Atomic Energy Commission, BMI-1401*, Dec. 10, 1959, 37 pp. (UF767 U3b Contin.)

7118 Internal Bremsstrahlung Spectrum Accompanying Ik Electron Capture in Decay of Fe^{55}, Cs^{131} and Tl^{204}. The internal Bremsstrahlung spectra in coincidence with the K X-rays resulting from 1S electron capture in Fe^{55} and Cs^{131} have been measured. The shape of the coincidence spectra exhibits a maximum at the predicted energy and then drops off in intensity toward the low energy region. The agreement between the observed coincidence shape and that predicted by Glauber and Martin for the radiative capture of S electrons is excellent. ***Marion H. Biavati.*** *U. S. Atomic Energy Commission, CU-190*, May 25, 1959, 54 pp. (UF767 Un3.1cu Contin.)

7119 Relative Effectiveness of Reactor Control Materials. The boron equivalence of the high cross section elements for slab geometries was measured. Data were obtained for several thicknesses of 19 elements. ***Richard A. Becker and John L. Russell, Jr.*** *U. S. Atomic Energy Commission, GEAP-3201*, July 20, 1959, 48 pages. (UF767 Un3.1gea Contin.)

7120 A Calculation of the Reactivity Worth of Plutonium and Uranium-235 as Enrichment in Thermal Reactors. This report presents, for a few specific cases, a comparison of the reactivity worth of Pu with the worth of U-235 as a thermal reactor fuel. Plutonium-239 has a greater reactivity worth in low neutron loss thermal reactors than either U-235 or Pu-239. In reactors having high neutron losses, Pu containing appreciable percentages of the higher isotopes cannot attain as long exposures as the corresponding U-235 enriched fuels. ***D. P. Granquist.*** *U. S. Atomic Energy Commission, HW-59758*, Aug. 8, 1959, 34 pp. (UF767 Un3.1hw Contin.)

7121 The Irradiation of Thin Evaporated Films of Uranium Dioxide—Interim Report. Electron microscopy of evaporated films of uranium dioxide, irradiated at a temperature below 60 C to an exposure of only 2.3 x 10^{16}nvt, thermal, discloses the presence of fission fragment trajectories with the diameters of 150 A. Each of the continuous trajectories observed corresponds to a fission event in the film. The relative intensities of the various lines which comprise the electron diffraction pattern of the thin uranium dioxide films change during irradiation. ***T. K. Bierlein and B. Mastel.*** *U. S. Atomic Energy Commission, HW-61656*, Sept. 9, 1959, 21 pp. (UF767 Un3.1hw Contin.)

7122 A Comparison of PCTR and Critical Experiment Determinations of k_∞ for Two Weight Per Cent Uranium-235 Enriched UF_4 in Paraffin. The value of k_∞ for 2 w/o U^{235} enriched UF_4 paraffin moderated at a H/U^{235} atomic ratio of 195 was determined in the PCTR. The value of k_∞ determined in the PCTR was 1.216 ± 0.013. The value obtained from the work carried out at the Oak Ridge National Laboratory was 1.200 ± 0.011 from a one-group treatment of the critical experiments and 1.202 ± 0.012 from a two-group treatment of the work. ***V. I. Neeley.*** *U. S. Atomic Energy Commission, HW-62031*, Sept. 22, 1959, 33 pp. (UF767 Un3.1hw Contin.)

7123 ETR Fast Neutron Flux Measurements $\phi > 1$ Mev. Flux maps of the ETR tank and traverses for all positions monitored are included. The measurements for Cycle 10 include data for a clean core and a fully depleted core. The theory on which the adopted measurement techniques are based is also described. ***C. H. Hogg and L. D. Weber.*** *U. S. Atomic Energy Commission, IDO-16535*, Jan. 8, 1960, 70 pp. (UF767 Un3.1id Contin.)

7124 Estimates of the Effect of Bubble Size on Fuel Element Swelling. Fission gases are a source of swelling in irradiated fuel materials; in a mechanically strengthless material, only surface tension limits the amount of swelling. In such materials, the amount of swelling depends upon the operating temperature, fuel burnup, and the number of gas-filled bubbles per unit volume of material. Swelling is insensitive to the variety of sizes of the gas-filled bubbles. ***A. H. Willis.*** *U. S. Atomic Energy Commission, KAPL-2050*, Sept. 30, 1959, 13 pp. (UF767 Un3.1ka Contin.)

7125 Uranium Surface Contamination on Nuclear Reactor Fuel Elements. This report is concerned with surface U^{235} contamination on nuclear reactor fuel elements. The nature of the contamination and the resultant hazards from plant contamination in the event of a primary system leak was discussed. Several successful methods for detecting and measuring surface contamination are described. The various approaches to decontamination are considered. ***W. M. Cashin, editor.*** *U. S. Atomic Energy Commission, KAPL-2061*, Oct. 23, 1959, 62 pp. (UF767 Un3.1ka Contin.)

7126 Particle Orbits in a Rotating Magnetic Field. Magnetic fields rotating at a radio frequency were proposed as a possible method for confining a plasma. The following note is devoted to determining the orbit of a charged particle in a rotating magnetic field. ***Bergen R. Suydam.*** *U. S. Atomic Energy Commission, LAMS-2371*, Oct. 1959, 11 pp. (UF767 Un3.1La Contin.)

7127 Fields Excited by Beam Currents in Circular Accelerators. Formulas are given for the electric and magnetic fields in a circular accelerator of arbitrary cross section, excited by a non-scalloping beam of particles. Both steady-state and step-function transients are considered. ***J. Van Bladel.*** *U. S. Atomic Energy Commission, MURA-538*, Dec. 28, 1959, 22 pp. (UF767 Un3.1mu Contin.)

7128 Thermonuclear Project Semiannual Report for Period Ending July 31, 1959. DCX operation and performance, vacuum arc research, ion source and accelerator development, instrumentation, theory, engineering sciences group, cross section experiments, diffusion of deuterium in Cu, sputtering and surface physics, metallurgy, vacuum tests, DCX-2 are discussed. *U. S. Atomic Energy Commission, ORNL-2802*, Dec. 30, 1959, 138 pp. (UF767 U3o Contin.)

7129 The Scattering and Polarization of Spin One Particles. Introductive problems, optical models for spin-one particles, scattering amplitudes, cross section and polarization, transformation of polarization from center-of-mass to laboratory, double scattering, effect of magnetic deflection are discussed. ***G. R. Satchler.*** *U. S. Atomic Energy Commission, ORNL-2861*, Jan. 20, 1960, 41 pp. (UF767 U3o Contin.)

7130 Homogeneous Reactor Program Progress Report for Period May 1 Through October 31, 1959. Reports progress in the homogeneous reactor test, reactor analysis and engineering development, reactor materials research, chemical engineering development, supporting chemical research, and analytical chemistry. *U. S. Atomic Energy Commission, ORNL-2879*, Feb. 10, 1960, 255 pp. (UF767 U3o Contin.)

7131 Controlled Thermonuclear Research Quarterly Report. Progress of the controlled fusion program and results in a variety of fundamental plasma experiments are reported. *U. S. Atomic Energy Commission, UCRL-8887*, Sept. 10, 1959, 143 pp. (UF767 U3u Contin.)

7132 Theory of α-Decay. The derivation of the formulas which are then applied to discuss the ground state transitions of even-even and odd-even nuclei in the region around Pb^{208}, the fine structure of some α-decays in this region, and the formulas that are necessary to treat α-decays of deformed nuclei on the basis of the unified model are given. ***Hans J. Mang.*** *U. S. Atomic Energy Commission, UCRL-8931*, Oct. 1959, 72 pp. (UF767 U3u Contin.)

7133 The Elastic Scattering of 5-Bev π^- Mesons on Hydrogen. Particular attention is directed to the problem of background events. The data are analyzed in terms of the optical model because the angular distribution shows the sharp rise in the forward direction characteristic of diffraction scattering. The modified least-squares procedure used to fit the data is outlined. The results are compared with those derived from theory and other experiments. It is shown that the assumption that the proton acts like a black sphere leads to an elastic cross section much higher than observed. ***Richard Garland Thomas, Jr.*** *U. S. Atomic Energy Commission, UCRL-8965*, Nov. 3, 1959, 63 pp. (UF767 U3u Contin.)

7134 Two-Region Reactivity Worth Method for Analysis of Fuel-Poison Subassemblies. Calculations have indicated that accuracies within 2 g of U and 0.03 g of B should be expected, using the water-gap variation of the method discussed in this report. Variations in certain physical characteristics between subassemblies tend to introduce additional reactivity effects into the actual U-B analysis. ***J. C. Case.*** *U. S. Atomic Energy Commission, WAPD-TM-194*, Nov. 1959, 8 pp. (UF767 Un3.1wa Contin.)

7135* Pumping of Linear Accelerators. The solutions found for Orsay's great linear accelerator and a certain number of structure details were exposed in connection with the problem of maintaining vacuum in linear accelerators. Apart from the difficulty encountered in the necessity of placing a diffusion pump on the high frequency connecting waveguides, expectations have been generally correct and breakdowns through bad vacuum have been very scarce. (*In French and English.*) Le pompage des accélérateurs linéaires. ***R. Jean and R. Liot.*** *Vide*, v. 14, no. 83, Sept.-Oct. 1959, p. 311-319.

7136* Some Experimental Results on the Angular Intensity Distributions of Backscattering and Transmission From an Isotropic P^{32} β Source on Thick and Thin Plane Scattering Media. The P^{32} saturation backscattering component, named side scattering by Seliger, is verified and further investigated for thin Al foils in connection with transmission, by means of a simple small solid angle Geiger counter method. Variations occurring in the side scattering angular distribution, due to surface effects, are illustrated, and can explain some errors in absolute β counting, and are related to results reported by Kanter. ***William L. Buys.*** *Zeitschrift für Physik*, v. 157, no. 4, 1960, p. 478-489.

7137* Concerning the Ratio of the Cross Sections for the (*e*,*n*)- and (γ,*n*)-Process. The ratio of the cross sections for the (*e*,*n*)- and (γ,*n*)-process is derived with the use of the relativistic Coulomb Eigenfunctions for the continuous spectrum, used by Sommerfeld-Maue and Bethe-Maximon. Only the electric and magnetic dipole transitions are considered. For these transitions, the Coulomb correction to the Born approximation is calculated. The result of an estimation of the electric quadrupole transition is given. The effect of screening, and that of finite nuclear size, is estimated. (*In German.*) Über das Verhältnis der Wirkungsquerschnitte für den (*e*,*n*)- und (γ,*n*)-Prozess. ***Rudolf Rodenberg.*** *Zeitschrift für Physik*, v. 158, no. 1, 1960, p. 44-76.

See also: **6307** (reactor fuel rods); **6310** (radiation damage in graphite); **6329** (irradiation in chemical processing).

OPERATIONS RESEARCH

7138* The Long-Range Future of Operational Research. ***Ellis A. Johnson.*** *Operations Research*, v. 8, no. 1, Jan.-Feb. 1960, p. 1-23.

7139* A Forecasting Method for Management of Seasonal Style-Goods Inventories. In a study of the operations of a textile manufacturer, methods were developed for determining (based on sales data) the duration and timing of the selling seasons, and for forecasting total sales for the season for each individual item in the line, at different probability levels. ***D. B. Hertz and K. H. Schaffir.*** *Operations Research*, v. 8, no. 1, Jan.-Feb. 1960, p. 45-52.

7140* Application of Operations Research to Complex Financial Agreements—A Profit-Sharing Illustration. A number of cases have developed where operations-research techniques are necessary in deriving an acceptable interpretation of complex financial agreements. In the situation described in this paper, the initial approach to an involved profit-sharing-incentive plan lacked operational definition, and mathematical work was needed to translate the basic intent of the interested parties into a feasible set of calculating procedures. ***Melvin F. Shakun.*** *Operations Research*, v. 8, no. 1, Jan.-Feb. 1960, p. 65-81.

7141* Optimum Preventive Maintenance Policies. This paper studies two preventive maintenance policies—one which is most useful in maintaining simple equipment, and another which is useful in maintaining large, complex systems. ***Richard Barlow and Larry Hunter.*** *Operations Research*, v. 8, no. 1, Jan.-Feb. 1960, p. 90-100.

7142* Decomposition Principle for Linear Programs. A technique is presented for the decomposition of a linear program that permits the problem to be solved by alternate solutions of linear sub-programs representing its several parts, and a coordinating program that is obtained from the parts by linear transformations. ***George B. Dantzig and Philip Wolfe.*** *Operations Research*, v. 8, no. 1, Jan.-Feb. 1960, p. 101-111.

7143* The Problem of the Amber Signal Light in Traffic Flow. A theoretical analysis and observations of the behavior of motorists confronted by an amber signal light are presented. Criteria are given for the design of amber signal light phases through whose use "dilemma zones" can be avoided, in the interest of over-all safety in intersections. ***Denos Gazis, Robert Herman, and Alexei Maradudin.*** *Operations Research*, v. 8, no. 1, Jan.-Feb. 1960, p. 112-132.

See also: **6932** (linear programming in a foundry); **6944** (industrial engineering for a small foundry).

ORE AND MATERIALS BENEFICIATION

7144* Technical Advances in Milling and Process Metallurgy in Canada During 1959. Crushing, grinding, gravity concentration, hydrocyclones, filtration, concentration of base metal ores, flotation research, extraction metallurgy, new equipment, and other problems are discussed. ***D. E. Pickett and L. E. Djingheuzian.*** *Canadian Mining Journal*, v. 81, Feb. 1960, p. 188-195.

7145 Cyanide Leaching to Extract Copper From Zinc Concentrate. ***Norman Hedley and Howard Tabachnick.*** *Mining Engineering*, v. 12, Feb. 1960, p. 158-160.

7146 Recovery of Uranium From Uranium-Zirconium Fuel Scrap. Uranium containing less than 40 ppm Zr/U_3O_8 can be consistently obtained at increased U throughputs. ***T. P. Sprague.*** *U. S. Atomic Energy Commission*, Y-1282, Jan. 20, 1958 (Issued Feb. 2, 1960), 31 pp. (UF767 Un3.1y Contin.)

7147 Irreversible Changes in Response of Minerals to Electrostatic Separation After Heating. Irreversibility may be the result of an alteration of adsorption layers, volatilization of surface cations or anions, or an oxidation or reduction. ***Foster Fraas.*** *U. S. Bureau of Mines Report of Investigations* 5542, 1959, 26 pp. (TN21 Un3r Vis.)

7148 Extraction of Yttrium and Rare-Earth Elements From Arizona Euxenite Concentrate. ***Van E. Shaw.*** *U. S. Bureau of Mines Report of Investigations* 5544, 1959, 9 pp. (TN21 Un3r Vis.)

7149 Electrowinning Tungsten and Associated Molybdenum From Scheelite. ***J. B. Zadra and J. M. Gomes.*** *U. S. Bureau of Mines Report of Investigations* 5554, 1959, 23 pp. (TN21 Un3r Vis.)

7150 Experimental Treatment of Base-Metal Ores From California and Nevada. Simple treatment methods were employed. More complex treatments also were tried when necessary. The possibilities and limitations of the methods applied to the several ores are shown by the data herein reported. ***A. L. Engel and H. J. Heinen.*** *U. S. Bureau of Mines Report of Investigations* 5566, 1960, 9 pp. (TN21 Un3r Vis.)

7151 Liquid-Liquid Extraction of Rare-Earth Elements. Separatory funnel work using tri-n-butyl phosphate (TBP) for extracting ceric nitrate from solutions containing sulfate ion resulted in almost complete extraction. ***D. J. Bauer, A. C. Rice, and J. S. Berber.*** *U. S. Bureau of Mines Report of Investigations* 5570, 1960, 10 pp. (TN21 Un3r Vis.)

PHYSICS

7152 Theory of Oscillation of a Viscoelastic Fluid in a Circular Tube. The hydrodynamic theory for the axial sinusoidal oscillation of a viscoelastic fluid in a rigid tube of infinite length and circular cross section is given. The fluid is assumed to be incompressible. Its properties in sinusoidal shear are described by a complex coefficient of viscosity. An equation for the velocity profile is developed, and typical profile curves are presented. Equations for the acoustic impedance per unit length of tube are also obtained. ***George B. Thurston.*** *Acoustical Society of America, Journal*, v. 32, Feb. 1960, p. 210-213.

7153* The Structure Analysis of a Guinier-Preston Zone by Means of a Fourier Method. The structure of a G.-P. zone in Al-Cu alloy was analyzed using a Fourier transformation of the *amplitude* distribution near the reciprocal lattice point (200). For each atomic plane composing the zone, the content of Cu atoms and the displacement from the net plane of the matrix crystal have been determined. The Cu content was found to vanish after the second plane from the origin, giving the zone a quasi-two-dimensional structure. ***Kenji Doi.*** *Acta Crystallographica*, v. 13, pt. 1, Jan. 10, 1960, p. 45-49.

7154* A Useful Analytic Approximation to Atomic and Unitary Atomic Scattering Factors. Mentions the use of an atomic scattering factor suggested by Steinfink Least-squares parameters; coefficients of unique polynomials, accuracy of representation and suggested applications of tables are discussed. ***J. N. Silverman and S. H. Simonsen.*** *Acta Crystallographica*, v. 13, pt. 1, Jan. 10, 1960, p. 50-54.

7155* A Simple and Accurate Technique for the Correction of X-Ray Intensities for Angle Factors in the Equi-Inclination Method. A method for converting Weissenberg intensities to a relative $|F|^2$ scale is presented together with the relevant table of factors. The method is based on a simple change of variable and increases the accuracy. ***Tor Löfgren.*** *Acta Crystallographica*, v. 13, pt. 2, Feb. 10, 1960, p. 156-159.

7156* On the Similarity Rule in Magneto-Gas-Dynamics. A diabatic flow is considered to be a flow of an inviscid, non-heat conducting fluid with heat addition by means of sources, i.e., injection of heat. If, in addition, the flow takes place in an electromagnetic field, the sources of heat may be referred additionally to the Joule heat. This case is considered in the present paper. The governing fundamental equations are: the first law of thermodynamics, equation of motion, pressure-density-entropy relation, the equation of energy, Maxwell's equations and Ohm's law. ***M. Z. v. Krzywoblocki and J. Nutant.*** *Acta Physica Austriaca*, v. 13, no. 1, Jan. 1960, p. 1-18.

7157 Advances in Mass Spectrometry. High resolution mass spectrometry; mass spectrometry of solids; application of the mass spectrometer in organic chemistry (analysis and instrumental techniques; mass spectra and their interpretation); ionization and electron impact studies; use of the mass spectrometer in fundamental research are discussed in detail. ***J. D. Waldron, editor.*** 704 pp. 1959. Pergamon Press, New York. (QC451 W14a)

7158 Advances in Spectroscopy. The spectra of polyatomic free radicals, spectroscopy in the vacuum ultra-violet, the index of refraction of air, determination of the velocity of light, high resolution raman spectroscopy, modern infra-red detectors, the infra-red spectra of polymers, rotational isomerism about C-C bonds in saturated molecules as studied by vibrational spectroscopy are discussed. ***H. W. Thompson, editor.*** v. I. 363 pp. 1959. Interscience Publishers Inc., New York. (QC451 Ad95)

7159 Sensitive Method for Measurement of Magneto-Resistance Effect With Direct Currents and With Microwaves. An experimental investigation is made of the magneto-resistance effect in Bi at frequencies of 9.2×10^9, 1.5×10^9 and 1.1×10^9 c/s, in magnetic fields of intensities up to 6270 oersteds. Some results were also obtained using direct current. The method developed for the measurements is one of high sensitivity. In general form, the results are in agreement with the theoretical predictions of Donovan. ***D. E. Clark and J. G. Assenheim.*** *British Journal of Applied Physics*, v. 11, Jan. 1960, p. 35-38.

7160 Variation With Particle Size of the Effective X-Ray Absorption Coefficient of Heterogeneous Slabs. The effective absorption coefficient for transmission of X-rays through heterogeneous slabs differs from the weighted-mean absorption coefficient because of random fluctuations in the number of particles of each type of material along different parallel paths. The value of μ_{eff} is calculated for several models; for each it is less than $\langle \mu \rangle$, the difference becoming large for large particles. ***G. B. Mitra and A. J. C. Wilson.*** *British Journal of Applied Physics*, v. 11, Jan. 1960, p. 43-45.

7161* The Focusing of Radiation by a Random Surface When the Source Is at a Finite Distance. In this study, a random surface is characterized by four independent parameters. The distribution of F is found to depend on all four of these. When the surface is isotropic, the number of parameters is reduced to one, and the distribution is dependent on one parameter only. ***M. S. Longuet-Higgins.*** *Cambridge Philosophical Society, Proceedings*, v. 56, pt. 1, Jan. 1960, p. 27-40.

7162* Self-Consistent Fields Without Exchange for Pr^{3+} and Tm^{3+}. The radial wave functions for Pr^{3+} and Tm^{3+} and the contribution of the wave functions to Z are given in table form. The spin-orbit coupling constant and the values of the Slater integrals are also given. ***E. Cicely Ridley.*** *Cambridge Philosophical Society, Proceedings,* v. 56, pt. 1, Jan. 1960, p. 41-54.

7163* Interactions of the Fields in "Inverted Images". Interactions of localized fields with different coordinates which are reciprocal images with regard to certain inversions, especially CPT and M were suggested. The possibility of deducting the particular form V-A from the universal interactions of four fermions was shown. (*In French.*) Interactions des champs en "images d'inversion". ***Kuo-Hsien Tzou.*** *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences,* v. 250, no. 4, Jan. 25, 1960, p. 668-670.

7164* Photoelectric Determination of the Position of the Neutral Lines of a Slightly Birefringent Medium. The more birefringent an anisotropic medium becomes, the harder it is to determine the positions of its isoclines. In the two photoelectric analyzers described, the photoelectric current, alternately modulated, is made proportional to the angle to be measured. These photoelectric arrangements are compared to the corresponding visual analyzers. (*In French.*) Détermination photoélectrique de la position des lignes neutres d'un milieu faiblement biréfringent. ***Harold Wayland and Jacques Badoz.*** *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences,* v. 250, no. 4, Jan. 25, 1960, p. 688-690.

7165* Applied Cryogenics Superconductivity in Gyro Reduces Mechanical and Electrical Losses to "Almost Zero". Basic cryogenic phenomena: superconductivity, magnetic flux trapping, magnetic "insulation", critical field strength, high-frequency behavior. Possible applications of cryogenic phenomena, shaping of magnetic fields, frictionless bearings, motors, amplifiers. *Electromechanical Design,* v. 4, no. 2, Feb. 1960, p. 12-13.

7166 A Theoretical Study of Ion Plasma Oscillations. For planar geometry, the frequency of oscillations for both symmetric and transverse modes is independent of amplitude, while the frequency increases with amplitude for cylindrical symmetric oscillations. For both cylindrical and planar geometry, the presence of the anode boundaries reduces the frequency for transverse ion oscillations. ***W. W. Peterson and H. E. Puthoff.*** *IRE Transactions on Electron Devices,* v. ED-6, no. 4, Oct. 1959, p. 372-377. (TK1 In6.6ed Vis.)

7167 Electron Beam Characteristics in Radially Varying Periodic Magnetic Fields. Periodic magnetic fields are being widely used for the light-weight focusing of beams in high-power traveling-wave tubes. In many tube designs, there exists a considerable amount of radial variation in the magnetic focusing field. The effect of this radial field variation is investigated analytically. ***Curtis C. Johnson.*** *IRE Transactions on Electron Devices,* v. ED-6, no. 4, Oct. 1959, p. 409-412. (TK1 In6.6ed Vis.)

7168 Contemporary Plasma Physics. The manifold aspects of plasma physics are briefly described. Hypersonics, high impulse fuel systems, the Sherwood program, nuclear explosives, and microwave tubes represent key areas in modern technology demanding more basic knowledge of plasma interactions. ***Louis Gold.*** *IRE Transactions on Space Electronics and Telemetry,* v. SET-5, no. 4, Dec. 1959, p. 162-165. (TK1 In6.6r Vis.)

7169* A Study of Ultrasonic Effects on the Electrode Phenomena. Methods to obtain an acoustic power in the electrolytic cell, reproducible and high enough ($3.3W/cm^2$) to permit tests in the presence of cavitation. The frequency used was 960 kHz. Overheating of electrode in the ultrasonic field was prevented. Anodic and cathodic polarizations of metals were decreased when the acoustic power was higher than the level of the cavitation formation only responsible for 5 to 10% of this decrease. (*In French.*) Étude de l'action des ultrasons sur les phénomènes d'électrode. ***Jacques Guitton.*** *Journal des Recherches du Centre National de la Recherche Scientifique,* no. 48, Sept. 1959, p. 199-229.

7170 Characteristics of a Plasma Thermocouple. The operation of a Cs plasma thermocouple is described for a range of hot-junction temperatures from 1600 K to 2600 K and for a range of Cs pressures from 10^{-5} mm Hg to 2 mm Hg. Electromotive force and short-circuit current data are presented for cells containing three different emitter substances: Ta, ZrC, and (ZrC)(UC). ***R. W. Pidd, et al.*** *Journal of Applied Physics,* v. 30, Dec. 1959, p. 1861-1865.

7171 Thermoplastic Recording. A new method is described for recording electrical signals. Information is written at extremely high density by means of an electron beam on a film consisting of a low melting thermoplastic material. This can be projected as a full color image, or can be converted to an electrical signal. The tape, which is processed by quick heating, can be readily erased and reused. ***W. E. Glenn.*** *Journal of Applied Physics,* v. 30, Dec. 1959, p. 1870-1873.

7172 Development of Facets, Spirals, and Etch Pits on Copper Crystals by Heating to High Temperatures in High Vacua. Single crystal spheres of OFHC and 99.999% Cu were heated to temperatures of 950 to 1075° in high vacua. When an OFHC crystal was heated in a Cu cup, an appreciable number of pits were formed. In the case of the 99.999% Cu, facets parallel to the (111) and (100) planes were formed in small areas around the respective poles, and at certain temperatures etch pits were formed. ***F. W. Young, Jr. and A. T. Gwathmey.*** *Journal of Applied Physics,* v. 31, Feb. 1960, p. 225-230.

7173 Factors Affecting the Ductility and Strength of NaCl Single Crystals Tested in Flexure. An experimental investigation has revealed that the initial deformation of NaCl single crystals is anelastic rather than Hookean. The order of increasing ductility and strength with specimen pretreatment was found to be (1) heated at 135 C, (2) as cleaved, (3) coated with Ag, (4) heated at 135 C and then water polished, (5) water polished and then coated with Ag, (6) water polished, (7) water polished and then heated at 135 C, (8) annealed at 700 C, and (9) annealed at 700 C and then water polished. ***C. A. Stearns, A. E. Pack, and R. A. Lad.*** *Journal of Applied Physics,* v. 31, Feb. 1960, p. 231-234.

7174 Torsion Induced Recrystallization of Molybdenum and Tungsten Filaments. When an optimum amount of permanent twist is introduced in 3- to 10-mil filaments of Mo or W, single crystals up to 15 cm in length grow by either the moving gradient or Robinson techniques. About five turns per inch for W at 2500 K or for Mo at 1650 K was favorable. Although there is evidence of perfection in the volume of the crystals, the twist leaves a threadlike surface imperfection which remains even after severe heat treatment at evaporation temperatures. ***F. E. Gifford and E. A. Coomes.*** *Journal of Applied Physics,* v. 31, Feb. 1960, p. 235-237.

7175 Determination of Magnetization Distribution in Thin Films Using Electron Microscopy. Some new developments are reported in the technique of observing magnetization in thin ferromagnetic films by transmission electron microscopy, and the results of some observations are described that contribute to an understanding of the magnetic character of thin films. Two modes of operation of a microscope are explained, one using projector magnification alone, and one using both objective and projector lenses. The intensity distribution imates of the magnetization distribution in a thin film is derived from the Lorentz force acting on an electron passing through the film. ***Harrison W. Fuller and Murray E. Hale.*** *Journal of Applied Physics,* v. 31, Feb. 1960, p. 238-248.

7176 Effect of Electron Irradiation and Subsequent Thermal Treatment on Young's Modulus of Copper. Measurements of Young's modulus of Cu following high energy electron irradiation and subsequent heat treatment are reported. The modulus is observed in increase following short exposures at −190 C in three separate temperature regions, centered at approximately −45 C, −5 C, and +80 C. ***A. Sosin and L. L. Bienvenue.*** *Journal of Applied Physics,* v. 31, Feb. 1960, p. 249-252.

7177 Effect of Specimen Delocalization in Electron Diffraction Studies of Gas Molecules. The effect upon a normal electron diffraction pattern of an extraneous uniform distribution of the gaseous specimen is considered quantitatively. It is

shown that the delocalization of gas may lead to errors in internuclear distances of several thousandths of an Angstrom unit or more in conventional experiments. Equations are presented for the correction of experimental data. ***L. S. Bartell.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 252-254.

7178 Experimental Investigation of a High-Energy Density, High-Pressure Arc Plasma. The underwater spark is utilized to study the fundamental parameters of a plasma at 30,000 K and 10,000 atmos pressure. The 25-kv spark is obtained by underwater discharge of capacitors having a stored energy of 1800 joules, the inertia of the water providing the confinement necessary to develop high pressures. Kerr cell photographs show that spherical structures are formed around both electrodes under certain conditions. The plasma is 30% ionized and the total particle density is about 2×10^{27} per cubic meter. At this density the plasma radiates a blackbody spectrum. ***Edward A. Martin.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 255-267.

7179 Diffusion Coefficients, Solubilities, and Permeabilities for He, Ne, H_2, and N_2 in Vycor Glass. The permeability of a Vycor filter is given for He at six temperatures ranging from 229 K to 723 K, for neon and H at 673 K and 723 K, and for N at 673 K. Helium appears to deviate from activated diffusion in Vycor somewhere between 100 and 26 C. On the basis of observed permeation rates for the above gases, it is estimated that the filtered He has impurity content of less than 1/50th of its unfiltered value. ***C. C. Leiby, Jr. and C. L. Chen.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 268-274.

7180 Submillimeter Wave Maser. It is shown that coherent emission between the levels $3^2P_{3/2}$ $-3^2P_{1/2}$ for Na atoms enclosed in a resonant cavity should occur at a rate greater than in free space where transition probabilites are very low. It is therefore proposed to operate a maser at the submillimeter wavelengths corresponding to these transitions using a dielectric tube resonator as the cavity. ***Saul M. Bergmann.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 275-276.

7181 Propagation of Large Amplitude Waves in Annealed Aluminum. An experimental study of large amplitude compression waves in annealed Al for the case of constant velocity impact has given a close agreement with the strain rate independent theory of one-dimensional plastic wave propagation. Propagation velocities, maximum strain, and energy considerations are in agreement with predictions from the slopes of the static stress-strain curve. ***James F. Bell.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 277-282.

7182 Growth, Structure, and Properties of Graphite Whiskers. Graphite whiskers have been grown in a dc arc under a pressure of 92 atmospheres of Ar and at 3900 K. They are embedded in a solid matrix of graphite which builds up by diffusion of C vapor from the positive to the negative electrode. Diameters range from a fraction of a micron to over five microns, with recoverable lengths up to 3 cm. ***Roger Bacon.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 283-290.

7183 Ion Drift in an *n-p* Junction. If a reverse bias is applied to an *n-p* junction at a sufficiently elevated temperature to give either the donor or the acceptor ions appreciable mobility, the ions will drift in the electric field of the junction to produce an intrinsic semiconductor region between the *n* and *p* regions. Such ion drift offers a simple and straightforward method for investigating diffusion constants, as well as chemical interactions within the host lattice which affect this diffusion. ***E. M. Pell.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 291-302.

7184 Diffusion of Boron Into Silicon. The diffusion of boron into silicon has been investigated over a temperature range of 1050 C to 1350 C using an open-tube vapor-solid diffusion technique at atmospheric pressure. A *p-n* junction method of measuring the diffused layer was used to determine the diffusion constant. Lower diffusivities and a somewhat lower activation energy, ($\Delta H = 81$ kcal) were obtained than those reported previously. ***A. D. Kurtz and R. Yee.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 303-305.

7185 Photoelectronic Analysis of High Resistivity Crystals: (a) GaAs, (b) Sb_2S_3. A series of photoelectronic measurements was used to obtain information about the following basic properties of high resistivity crystals: (1) majority carrier lifetime, (2) band gap, (3) activation energy for dark conductivity, and (4) activation energies and densities of trapping centers for carriers. The results are reported here together because both crystals show evidence for trapping of photoexcited carriers by compensated donor centers of the same type as those which uncompensated give rise to the normal dark conductivity. ***Richard H. Bube.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 315-322.

7186 Thermal Initiation of Explosives. Numerical solutions have been obtained for the nonlinear heat conduction equations arising in the theory of thermal explosions. Explosion times are calculated for externally heated spheres, cylinders, and slabs of several explosive materials, and the results are shown to agree with experiment. ***John Zinn and Charles L. Mader.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 323-328.

7187 Single Crystal Tungstates for Resonance and Emission Studies. Compositions such as monoclinic $MgWO_4$, $ZnWO_4$, $CdWO_4$, and tetragonal $CaWO_4$, $SrWO_4$, and $BaWO_4$ containing paramagnetic ions of the transition and rare earth series have been prepared. They were grown by dissolving the constituent oxides into an equimolar mixture of Na_2WO_4 and WO_3 at 100 to 1250 C and cooling at 2 to 3 C per hour to 700 C. ***L. G. Van Uitert and R. R. Soden.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 328-330.

7188 Effect of the Polarity of the III-V Intermetallic Compounds on Etching. The shape of etch pits bounded by crystallographic planes and the presence or absence of pits at dislocations are influenced by the effect of the polar axes on the etch rates. Studies of these effects are reported for several etches on InSb, InAs, GaSb, and GaAs. ***J. W. Faust, Jr. and A. Sagar.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 331-333.

7189 Effect of Oxide Layers on the Diffusion of Phosphorus Into Silicon. The diffusion of P from the vapor phase into single crystal Si has been studied. The experimental data are analyzed in terms of a two-layer diffusion model, leading to the determination of a diffusion constant for P in the oxide. The resulting diffusion constant at 1150 C is found to be 2.1×10^{-15}cm/sec^2 with an activation energy of 1.4 ev. ***R. B. Allen, H. Bernstein, and A. D. Kurtz.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 334-337.

7190 Theory of Fast-Wave Parametric Amplification. A new type of low-noise beam-type parametric amplifier has recently been introduced by Adler, Hrbek, and Wade. This device is characterized by its use of the fast-cyclotron wave for amplification purposes instead of the conventionally used slow space-charge wave. The fast-cyclotron wave is selected because it can be made relatively noiseless by appropriate coupling processes. ***Curtis C. Johnson.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 338-345.

7191 Observations on MnBi Films During Heat Treatment. A vacuum hot stage for a metallurgical microscope was constructed in order to accomplish by means of the Kerr magneto-optic effect this visual observation of incipient ferromagnetism. MnBi films with some areas already magnetic were first observed. The phenomena occurring during evolution of the magnetic state in the areas adjacent to the already magnetic areas could be observed readily. ***Ludwig Mayer.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 346-351.

7192 Detailed Study of Switching Current in Barium Titanate. The polarization reversal process in ferroelectrics has, up to now, been characterized solely by the total switching time and the maximum value of the switching current. The work presented in this paper was aimed at determining how the instantaneous value of the switching current in single crystals of $BaTiO_3$ depends on the applied field, the state of net polarization of the crystal, and possibly other factors. It has been found that the switching current density can be expressed as the product of a function of the polarization, $\phi(p)$, and a function of the electric field, $\exp(-a/E)$. ***M. E. Drougard.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 352-355.

7193 Decay of Wax Electrets. The internal field within an electret can be varied by changing the spacing and arrangement of shielding electrodes ("partial shielding"). The application of this technique to rosin-wax electrets shows that the

charge decay observed upon unshielding electrets is caused primarily by volume polarization due to internal field rather than by external ion collection. ***M. M. Perlman.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 356-357.

7194 Theory of Non-Newtonian Flow. III. A Method for Analyzing Non-Newtonian Flow Curves. The historical development of the rate theory of viscosity is briefly reviewed. The Ree-Eyring equation of generalized viscosity is applied successfully in a variety of cases. We develop a new method for determining the parameters X_n/α_n and β_n. According to this method, these parameters are uniquely determined. ***Wan Kyue Kim, et al.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 358-361.

7195 Mobility of Edge Dislocations in Silicon-Iron Crystals. A method has been developed whereby the velocity of motion of fresh dislocations introduced into a crystal by scratching the surface may be measured as a function of stress. The velocities of unpinned edge dislocations in 3¼% Si-Fe have been measured as a function of stress over a range of five orders of magnitude in velocity from 10^{-7} cm/sec to 10^{-2} cm/sec. The velocity has been found to be very sensitive to the applied stress in this velocity range. It has been found that over this range of temperature the yield stress changes with temperature in the same way as the stress to produce a constant velocity of dislocation motion. ***Dale F. Stein and J. R. Low, Jr.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 362-369.

7196 Single-Velocity Equivalents for Multivelocity Electron Streams. Several electron beam problems which involve a distribution in electron velocities are treated. In each case the actual multivelocity stream is replaced by an equivalent single-velocity stream. Such a procedure provides a common viewpoint for the examples which are considered. For a traveling wave tube, it is found that a distribution of dc electron velocities has the same effect as an increase in the space charge parameter QC, as result which is in agreement with the earlier findings of Watkins and Rynn. ***Glenn A. Gray.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 370-380.

7197 On the Concept of Fictitious Surface Charges of an Electron Beam. The electrodynamical phenomena in the boundary strip of a sharply focused electron beam are extremely complicated. This difficulty is usually resolved by postulating a layer of surface current on the boundary of the unperturbed beam while considering the troublesome boundary strip as nonexistent. A critical examination is made of this technique with the result that, if the calculated rf power is to be the same is in the actual beam, a layer of electric dipoles must also be postulated. ***E. L. Chu.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 381-388.

7198 Method for the Detection of Flaws in Yttrium Iron Garnet Crystals. Infrared techniques similar to those used in examining Si crystals have been applied to the examination of yttrium iron garnet crystals. Photographic results for both flux grown and sintered crystals are given. ***E. Buehler and M. Tanenbaum.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 388-390.

7199 Thermal Attenuation of Nonlinear Stress Waves. The work of Knopoff and MacDonald (1958) on the attenuation of nonlinear stress waves in solids has been extended to include thermal losses. The damping of a nonlinear stress wave is completely describable in terms of two attenuation coefficients, a "mechanical" coefficient α_1, and a "thermal" coefficient α_2. ***Sren Treitel.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 391-395.

7200 Operating Characteristics of a Molecular-Beam Maser. General expressions for the emitted power and the frequency pulling in an ammonia maser have been deduced. The operating characteristics of the maser have been deduced by introducing a mean-square time of flight of molecules in the cavity. ***H. G. Venkates and M. W. P. Strandberg.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 396-399.

7201 Ion Energies in a Cold Cathode Discharge in a Magnetic Field. The discharge was run at pressures of a few microns with magnetic fields of 2400 gauss and currents of the order of half an ampere. By means of a multivibrator and amplifier the discharge was pulsed off for 300μ sec at 1000μ sec intervals. During the off period the current flow to the cathodes was observed. Analysis of the current flow shows an approximately Maxwellian distribution of velocities at the cathodes with a temperature of about 0.5 ev. This gives an ion density in the discharge of approximately 20%. ***John Backus and Norman E. Huston.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 400-403.

7202 Structure in Vitreous Silicate Fibers as Shown by Small-Angle Scattering of X-Rays. The relation of the X-ray diagram at small angles to the preparation conditions of glass fibers from molten silicates is studied. The composition $Na_2O \cdot MgO \cdot 3SiO_2$ is studied extensively, and fibers are also studied in which K_2O replaces Na_2O, and CuO and PbO replace MgO. Most of the diagrams are characterized by very intense, unshaped diffraction maxima. The diffuse scattering is interpreted as due to voids which are elongated by the spinning process. ***W. O. Statton and L. C. Hoffman.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 404-409.

7203 Precision Lattice Parameter Measurements of Cold-Worked Metals. A technique is developed for precise measurement of interplanar spacings under conditions such that both crystal imperfections and the finite X-ray spectrum contribute significantly to the broadening of the diffraction peaks. This is accomplished by considering the variation of the interference function in the neighborhood of a reciprocal lattice point. ***Robert Asimow.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 410-412.

7204 Microwave Study of Afterglow Discharge in Water Vapor. Results of a microwave investigation of decaying plasmas produced in water vapor H_2O are reported. Electron loss processes prevailing in these decaying water vapor plasmas were interpreted. In the electron density range from 10^{10} to 10^{9} per cm^3, electron-ion recombination prevails as the dominant electron loss process with a coefficient of 10^{-6} to 10^{-5} cm^3/sec. ***Susumu Takeda and Arwin A. Dougal.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 412-416.

7205 Absorption and Reflection Spectrum of a Plasma. A series of absorption and reflection peaks for plasmas, cylindrical in form, and occurring at electron densities lower than that required for the conventional plasma frequency, has been reported by various workers such as Tonks, Rommel, and Dattner. This paper describes experiments at a wavelength of 10 cm in which the multiple resonances are observed both within a wave guide and in free space. The electric field of the incident microwave is perpendicular to the axis of the plasma column. ***W. D. Hershberger.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 417-422.

7206 Monoenergetic Neutron Irradiation of Germanium. A study has been made on 14-Mev neutron-irradiated Ge, using lifetime, Hall, and resistivity measurements to determine the nature of the radiation-induced defects and to compare the damage with that produced by neutrons from a fission spectrum. The electron removal rate in high-resistivity, n-type material is $\sim 8/\text{cm}^3$ per incident neutron/cm^2, measured at 77 K. Lifetime measurements have been made on n- and p-type material. ***O. L. Curtis, Jr. and J. W. Cleland.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 423-427.

7207 Microwave Determination of Plasma Density Profiles. A method for the rapid determination of the average electron density and of the spatial electron density distribution in plasmas is presented. The technique employed permits time-resolved measurements over a wide range of electron densities, introducing little or no perturbation into the gaseous discharge. ***Charles B. Wharton and Donald M. Slager.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 428-430.

7208* Theory of the Focusing of Sheet Beams in Periodic Fields. Equations determining the paraxial behavior of sheet beams in periodic focusing fields are established. Space-charge is taken into account, and its effect upon stability is investigated. It is proved that, if space-charge is neglected, any such focusing system is convergent. ***P. A. Sturrock.*** *Journal of Electronics and Control*, v. 7, no. 2, Aug. 1959, p. 153-161.

7209* Magnetic Deflection Focusing. A scheme for focusing sheet beams by means of a periodic configuration of magnetic fields directed transverse to the beam is presented. Discussion of

a particular model gives information about stability limits and perveance. This scheme, which lends itself to the incorporation of intense magnetic fields, should be immune to the space-charge instabilities of beams focused in longitudinal magnetic fields. ***P. A. Sturrock.*** *Journal of Electronics and Control*, v. 7, no. 2, Aug. 1959, p. 162-168.

7210* The Effect of Temperature on Ultraviolet Absorption Spectra and Its Relation to Hydrogen Bonding. All the absorption spectra characterized by π-π^* transition exhibit a large red shift and an increase in total absorption intensity with decreasing temperature when H bonds are formed between the solute and solvent molecules. The total absorption intensity of the n-π^* transition of acetone decreased progressively with decreasing temperature even when no special interaction existed between acetone and solvent molecules. When H bonds were formed between these molecules, a blue shift in the absorption maximum is observed in addition to a decrease in the total absorption intensity. ***Mitsuo Ito.*** *Journal of Molecular Spectroscopy*, v. 4, no. 2, Feb. 1960, p. 106-124.

7211 Design and Performance of a Rapid-Scanning X-Ray Diffractometer. The apparatus described enables the equatorial X-ray diffraction intensity distribution from radially symmetrical specimens to be obtained over the angle range 0 to 20° of Bragg θ in 20 seconds. Sequential scans are performed at the rate of two per minute and the X-ray intelligence is retained in the form of pulses by being recorded on magnetic tape which preserves the record with a high degree of fidelity. Also incorporated is an intensity analyzer which enables the integrated count to be obtained between any two preset positions of Bragg θ, the limits being adjustable in steps of 0·1° to a high degree of precision. ***A. Skertchly.*** *Journal of Scientific Instruments*, v. 37, Jan. 1960, p. 6-14.

7212 Densitometer Wedge for Measurements at Low Optical Densities. For the quantitative evaluation of electron micrographs a continuous wedge has been simply made in which, over the range 0 to 1.0, the optical density varies exponentially along its length within an accuracy of ± 5%. Its construction and method of use are described. An application is indicated in measurements of the mass of electron-microscope specimens and similar uses in contact microradiography and microspectrophotometry are suggested. ***N. R. Silvester.*** *Journal of Scientific Instruments*, v. 37, Jan. 1960, p. 33-34.

7213* Ultra-High Vacuum. The equipment employed in the study of surface phenomena, gas discharges, nuclear fusion, and ultra-pure thin films is described. *Mechanical World and Engineering Record*, v. 140, Feb. 1960, p. 58-62.

7214* Thermal Diffusion and the Approach to the Steady State in Gases. II. The theory of the rate of approach to the steady state in thermal diffusion is tested experimentally on the systems He-Ar, He-CO_2, H_2-CO_2, and D_2CO_2 over a temperature range of about −78 c to 325 c. The course of the diffusion has been followed by means of the radioactive tracers ^{37}Ar and $^{14}CO_2$. The theory appears to be verified, and the results are used to calculate ordinary diffusion coefficients, which are in reasonable accord with previous measurements by other techniques. ***S. C. Saxena and E. A. Mason.*** *Molecular Physics*, v. 2, no. 4, Oct. 1959, p. 379-396.

7215 Generation of Temperatures Below 1°K. The investigations confirm the existence in solid He-3 at low temperatures of forces additional to the magnetic spin-spin interaction. ***D. F. Brewer.*** *Nature*, v. 185, Feb. 6, 1960, p. 349-350.

7216* On the Effect of Total Reflection on the Optimum Dimensions of Collimators for Neutron Crystal Spectrometers and Diffractometers. We examine the effect that is exercised by the total reflection developing at the walls of primary collimators used in neutron diffractometers and crystal spectrometers on the optimum dimensions of such collimators. The formulae for computation of the intensity transmitted by a single total reflection are given. ***P. Szabó.*** *Nuclear Instruments and Methods*, v. 6, Jan. 1960, p. 183-186.

7217* Topics in the Theory of Dispersion Relations. The mathematics and physics of the theory of dispersion relations are discussed, with particular reference to the quantized field description of the scattering by a fixed center. Various known analytic continuations of physical data are examined for mathematical stability, and the dispersion relation at fixed momentum transfer is proved by a simple method which is susceptible to the operations of numerical analysis. The scattering problem is formulated entirely in terms of the fields at large but finite distances from the scatterer, and this leads to a direct and perspicuous treatment of the "unphysical" region. The effect of finite violations of microscopic causality is expressed quantitatively through a new dispersion relation which, while still dealing only with accessible scattering data, embodies within itself a fundamental length. ***G. R. Allcock.*** *Nuclear Physics*, v. 14, no. 2, Dec. 1959, p. 177-198.

7218* Three-Field Theory of Strong Interactions. A theory of strong interactions which uses only three massless fundamental fields is discussed. This theory gives all additive constants of the motion but not C and P separately. ***W. Thirring.*** *Nuclear Physics*, v. 14, no. 4, Jan. 1960, p. 565-577.

7219* Pseudo-Cluster Expansion. Formulas are derived expressing the total energy and the diagonal and non-diagonal matrix elements of operators by the asymptotic wave functions. ***J. Fujita.*** *Nuclear Physics*, v. 14, no. 4, Jan. 1960, p. 648-660.

7220 Streak Interferometry. A modification of the Mach-Zehnder interferometer is described which permits streak interferometry of transient axisymmetric flows. Features of the interferograms include (1) clearly defined shock waves, (2) a narrow, transparent, flow region behind the strong shock where fringes may be seen, (3) an opaque region, and (4) luminous regions associated with the second shock wave. ***F. D. Bennett, D. D. Shear, and H. S. Burden.*** *Optical Society of America, Journal*, v. 50, Mar. 1960, p. 212-216.

7221 Pressure Dependence of the Critical Field in Indium Single Crystals. The pressure dependence of the critical magnetic field in single crystals of In has been calculated from measurements of length changes at the transition. ***H. Rohrer.*** *Philosophical Magazine*, v. 4, ser. 8, Nov. 1959, p. 1207-1212.

7222 Incoherent Microwave Radiation From Plasmas. A study is made of the incoherent radiation from an isotropic, quiescent plasma of a low degree of ionization. Three cases are treated theoretically: the transparent plasma, the semi-opaque plasma, and the opaque plasma. Radiation from positive columns of dc glow discharges in He and H for the three cases treated theoretically are studied experimentally at 3000 Mc/sec, and good agreement is obtained between theory and experiment. ***G. Bekefi, Jay L. Hirshfield, and Sanborn C. Brown.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1051-1056.

7223 Velocity of Sound in Liquid He^3 at High Pressures. The velocity of 14-Mc/sec sound in liquid He^3 was measured at pressures up to nine atmospheres in the temperature range 1.2 K to 3.2 K. A few measurements were also made in the gas just above the critical temperature. A possible phonon contribution to the thermal coefficient of expansion of the liquid is discussed. ***K. R. Atkins and H. Flicker.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1063-1068.

7224 Thermoluminescence of X-Ray Colored NaCl Crystals. Glow curves and thermoluminescence spectra taken at various temperatures during the glow have been recorded simultaneously. Spectra were obtained with a rapid-scanning spectrophotometer using a liquid-air cooled photomultiplier in conjunction with a cathode-ray oscilloscope. Peaks of the same wavelength were found to be repeated several times in the temperature range of 80-600 K. Thermal pretreatment was found to enhance the various glow peaks by factors of a few thousands. ***A. Halperin, N. Kristianpoller, and A. Ben-Zvi.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1081-1089.

7225 Antiferromagnetic Linear Chain. Orbach's integral equation which leads to the value of the ground-state energy of an anisotropic antiferromagnetic linear chain of spins, $S = \frac{1}{2}$, has been solved. The result is then expanded in powers of the anisotropy parameter. In this form it corresponds to the result of a perturbation calculation, the transverse part of the Hamiltonian being the perturbation. The rapid convergence of the energy series even for the isotropic case and the adequate convergence of that for the short range order, suggests that the result given by perturbation theory for the sublattice magnetization may also be satisfactory. ***L. R. Walker.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1089-1090.

7226 Exciton States in Ionic Crystals. Exciton states in ionic crystals are analyzed according to configurations allowed by cubic point symmetry. The "excitation" and "electron transfer" models of the exciton structure are reintroduced as two slightly different aspects of the same general group-theoretical problem. Predictions of these models concerning multiplicity of absorption peaks are shown to be essentially identical. ***R. S. Knox and N. Inchauspé.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1093-1099.

7227 Ultraviolet Absorption of Alkali Halides. The absorption spectra of evaporated films of the alkali halides, with the exception of LiF, have been measured at room temperature and 80 K in the region from 1100 to 2500 A. The spectra are rather complex at low temperature, but agree fairly well with current theory concerning the multiplicity and grouping of the exciton peaks. In addition, a shoulder has been found in many of the spectra, similar to the ones previously seen and associated with the band-to-band transition in the alkali iodides. ***J. E. Eby, K. J. Teegarden, and D. B. Dutton.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1099-1105.

7228 Relative Measurement of the Photodetachment Cross Section for H^-. The spectral dependence of the photodetachment cross section for the negative ion of atomic H has been measured in the range from 4000 A to 13,000 A with approximately 300-A resolution. Measurements were made with 25 band pass filters, each measurement taken relative to the value obtained with a control filter at 5280 A. A probable error of about 2% is attached to the relative value obtained for each filter. The results are in significant disagreement with available calculated cross sections. ***Stephen J. Smith and David S. Burch.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1125-1131.

7229 Interference of Orbital and Spin Currents in Bremsstrahlung and Photoelectric Effect. The matrix elements of the Born approximation theory of bremsstrahlung are resolved into sums of terms classified according to whether the radiation interacts with orbital or with spin currents and on the basis of additional spin effects which result from electron motion before and after the emission. Observable features of angular distribution, X-ray polarization, and spin orientation can be interpreted as effects of interference between the separate terms. The results are applicable to corresponding features of the photoelectric effect. ***U. Fano, K. W. McVoy, and James R. Albers.*** *Physical Review*, v. 116, 2nd ser., no. 5, Dec. 1, 1959, p. 1159-1167.

7230 Ground-State Energy of Bose-Einstein Gas With Repulsive Interaction. The explicit evaluation of the ground-state energy of a Bose gas interacting through a two-body repulsive potential as an expansion essentially in powers of the density of the particles and the scattering length is given. It is shown that the problem can be treated by using diagrammatical analysis up to any orders. The energy was investigated up to the fourth order in the ordinary sense of a perturbation expansion in terms of the scattering length, but including terms up to infinite order for special classes of diagrams. ***Katuro Sawada.*** *Physical Review*, v. 116, 2nd ser., no. 6, Dec. 15, 1959, p. 1344-1358.

7231 Theory of Displacement Cascades in Compounds. The theory undertakes the determination, for a simple model, of functions $N_{1k}(T)$ which represent the numbers of atoms of various kinds displaced when a primary atom receives an energy T. Assuming isotropic collisions involving pairs of free atoms, differential equations are formulated which contain concentrations, collision cross sections and mass ratios as parameters. Binding of the atoms is introduced through initial conditions which define threshold energies for displacement. ***E. M. Baroody.*** *Physical Review*, v. 116, 2nd ser., no. 6, Dec. 15, 1959, p. 1418-1424.

7232* Stable Confinement of a High-Temperature Plasma. Theoretically, there are relatively few plasma-magnetic field configurations which should permit stable confinement. Even these, when experimentally tested, have until now been found to be unstable, forcing re-examination and extension of the theory. Reports experiments which represent a contrary example, providing evidence for the existence of a stably confined plasma, observed under circumstances where the simplest hydromagnetic theory predicts instability. ***R. F. Post, R. E. Ellis, F. C. Ford, and M. N. Rosenbluth.*** *Physical Review Letters*, v. 4, no. 4, Feb. 15, 1960, p. 166-170.

7233 Test Particles in a Completely Ionized Plasma. ***Norman Rostoker and M. N. Rosenbluth.*** *Physics of Fluids*, v. 3, no. 1, Jan.-Feb. 1960, p. 1-14.

7234 Experimental Study of Alfvén-Wave Properties. ***John M. Wilcox, Forrest I. Boley, and Alan W. DeSilva.*** *Physics of Fluids*, v. 3, no. 1, Jan.-Feb. 1960, p. 15-19.

7235 Cyclotron Radiation From a Hot Plasma. ***W. E. Drummond and M. N. Rosenbluth.*** *Physics of Fluids*, v. 3, no. 1, Jan.-Feb. 1960, p. 45-51.

7236 Plasma Physics and the Problem of Controlled Thermonuclear Reactions. Contains a large and authoritative selection of articles on the theoretical and experimental investigations carried out at the Institute of Atomic Energy of the U.S.S.R. Academy of Sciences between 1951 and 1958. (Translated from the Russian by A. J. Meadows, D. L. Allan, and N. Kemmer, F.R.S.) ***M. A. Leontovich.*** v. II. 457 pp. 1959. Pergamon Press, New York. (QC786 Ak13.1ftr)

7237* Equation of State of High Temperature Plasma. The equation of state of high-temperature plasmas is investigated in consideration of the quantum mechanics. It is shown that the Debye-Hückel approximation surely applies to the plasmas of low density of the order $10^{15} \sim 10^{17}$ at high temperatures where $\lambda_e \lesssim a_0/Z$, where Z is the charge of a nucleus, λ_e the de Broglie wave length of an electron, and a_0 the Bohr radius. ***Tohru Morita.*** *Progress of Theoretical Physics*, v. 22, no. 6, Dec. 1959, p. 757-774.

7238* On the Theory of Superconductivity. Bardeen, Cooper and Schrieffer's theory of superconductivity is discussed by developing an exact treatment of strong coupling approximation. With respect to the thermal properties, their results are verified. The energy of the ground state and the magnitude of the energy gap are found to be identical with the exact answers in the strong coupling limit. ***Yasushi Wada and Nobuyuki Fukuda.*** *Progress of Theoretical Physics*, v. 22, no. 6, Dec. 1959, p. 775-806.

7239 Lattice Statistics in a Magnetic Field. I. A Two-Dimensional Super-Exchange Antiferromagnet. The partition function of a two-dimensional 'super-exchange' antiferromagnet in an arbitrary magnetic field is derived rigorously. The model is a decorated square lattice in which magnetic Ising spins on the bonds are coupled together via nonmagnetic Ising spins on the vertices. By use of the decoration transformation, all the thermodynamic and magnetic properties of the model are derived from Onsager's solution for the standard square lattice in zero field. ***M. E. Fisher.*** *Royal Society, Proceedings*, v. 254, ser. A, Jan. 19, 1960, p. 66-85.

7240 Acoustic Radiation From a Turbulent Fluid Containing Foreign Bodies. The problem of the acoustic radiation from a turbulent fluid containing foreign bodies of arbitrary shape and arbitrary composition is solved formally by the method of Green functions. Particular attention is given to the radiation from the surface of these bodies. A practical advantage of the method is that provided an appropriate Green function can be found, either exactly or approximately, then knowledge of the values on the surface of the fluctuations in only one scalar variable is needed to permit estimation of the radiation from the surface. ***P. E. Doak.*** *Royal Society, Proceedings*, v. 254, ser. A, Jan. 19, 1960, p. 129-145.

7241 Space, Time and Gravitation. An Outline of the General Relativity Theory. Geometry, the FitzGerald contraction, relativity, the world of four dimensions, fields of force, kinds of space, the new law of gravitation and the old law, weighing light, other tests of the theory, momentum and energy, towards infinity, electricity and gravitation, on the nature of things. ***Arthur Eddington.*** 213 pp. 1959. Harper & Brothers, New York. (QC6 Ed23s)

7242 The Overhauser Effect in Paramagnetic Systems. The theory of the Overhauser nuclear polarization effect is discussed, and particular attention is paid to the expected sign of the nuclear magnetization. A negative nuclear polarization

could be used as a low-noise quantum mechanical amplifier of radiofrequency signals. Various systems which have been, or might be, investigated experimentally by simultaneous saturation of the electron or hole spin resonance and observation of an appropriate nuclear magnetic resonance frequency are given. ***William A. Barker.*** *U. S. Atomic Energy Commission, ANL-6069,* Nov. 1959, 36 pp. (UF767 Un3.1an Contin.)

7243 Standard Free-Air Chamber for the Measurement of Low Energy X-Rays (20 to 100 Kilovolts-Constant-Potential). The standard chamber is designed to measure the exposure dose in roentgens for X-ray beams generated at potentials from 20 to 100 kilovolts-constant-potential (kvcp) with filtrations ranging from two millimeters of Be to two millimeters of Be plus four millimeters of Al. The chamber was compared with the National Bureau of Standards "medium" energy standard at 60, 75, and 100 kvcp; the two standard chambers agreed to within 0.3%. ***Victor H. Ritz.*** *U. S. National Bureau of Standards, Journal of Research, Section C, Engineering and Instrumentation,* v. 64, no. 1, Jan.-Mar. 1960, p. 49-53.

7244* Quantum Statistical Evaluation of a Gas With Different Orbital and Spin Temperatures. A system of particles with spin in a magnetic field may possess an orbital temperature T_o different from the spin temperature T_s ($\gtrless 0$), if it is possible to neglect the energetic interaction between the orbital and the spin system. Apart from the Boltzmann-approximation being valid in the case of small spin values for $T_o > T_s$ (T_s = customary degeneration temperature) and arbitrary $T_s \gtrless 0$, the distributions and the orbital and the spin energy depend on both the temperatures T_o and T_s coming from the principle of exclusion for Fermi resp. Bose particles. The equations of state are discussed. (*In German.*) Quantenstatistik eines Gases mit verschiedener Bahn- und Spintemperatur. ***E. Fick.*** *Zeitschrift für Physik,* v. 157, no. 4, 1960, p. 407-432.

7245* Propagation Laws for Null and Type III Gravitational Waves. Several algebraic characterizations of vacuum-Type III metric fields are discussed. A covariant integral conservation law is obtained by introducing a divergence free vector density that is uniquely determined by the metric and Riemann tensors of a Type III metric. In a region where the gravitational field is of Type III almost everywhere, the vector density vanishes at a point if, and only if, the Riemann tensor vanishes there. The conserved quantity has the dimensions of energy, but is probably not simply related to energy in the ordinary sense. ***R. K. Sachs.*** *Zeitschrift für Physik,* v. 157, no. 4, 1960, p. 462-477.

7246* The Optical Properties of Interference Filters When Measuring With the Finite Width of the Spectral Ranges. A special procedure of evaluation permits—from measurements of the transmissibility of interference filters possessing a very narrow band width—the very accurate determination of both the half-width and the position of the transmitted spectral range. Using this procedure, a method is developed that eliminates those errors in the determination of the optical properties of the filters which are due to the finite width of the spectral range used for the measurements. Both methods are illustrated by experimental examples. (*In German.*) Die optischen Eigenschaften von Interferenzfiltern bei Messung mit endlich breiten Spektralbereichen. ***G. Koppelmann and K. Krebs.*** *Zeitschrift für Physik,* v. 157, no. 5, 1960, p. 592-600.

7247* A Method for Measuring Magnetic Fields in Superconductors. The field strength H(x) at a place x inside a superconductor is determined by the observation of the turning of the angular correlation of a γ-γ-cascade. The radioactive isotope needed in the case is built free of any carrier by means of a vaporization technique into the substance under investigation. This method was applied to observing the Meissner effect in Pb. The difficulties encountered are discussed. ***H. R. Lewis, J. F. Cochran, H. Frauenfelder, D. E. Mapother, and R. N. Peacock.*** *Zeitschrift für Physik,* v. 158, no. 1, 1960, p. 26-34.

7248* Approximation for the Functions of Three Field Operators in the Heisenberg's Theory. Heisenberg's approximation for the wave function of a fermion is modified by a more extended account for the corresponding function of three field operators. This may also contain a certain type of form factor, although the calculations already finished are done without any dependence on the internal coordinates. The result depends remarkably on the ambiguous sign of the nonlinear term in Heisenberg's field equation. (*In German.*) Genäherte 3-Punkt-Funktionen in der Heisenbergschen Theorie. ***K. Just, I. Hartmann and H. v. Ossowski.*** *Zeitschrift für Physik,* v. 158, no. 1, 1960, p. 39-43.

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7249 The Preparation and Polymerization of Fluorine-Containing Siloxanes. Preparation by the reaction of vinyl-substituted Si compounds with chlorotrifluoroethylene. Polymerization of the cyclosiloxanes, using H_2SO_4 catalysis, gave high molecular weight linear polysiloxanes. ***G. W. Holbrook, A. F. Gordon, and O. R. Pierce.*** *American Chemical Society, Journal,* v. 82, Feb. 20, 1960, p. 825-826.

7250 The Homopolymerization of Monoisocyanates. Monoisocyanates were polymerized at low temperatures by anionic catalysts to give linear high molecular weight polymers. The reaction is applicable to both aliphatic and aromatic isocyanates. The scope and limitations of the reaction are defined. Properties of the 1-nylons are described. ***Victor E. Shashoua, Wilfred Sweeny, and Raymond F. Tietz.*** *American Chemical Society, Journal,* v. 82, Feb. 20, 1960, p. 866-873.

7251 Copolymerization of Styrene and *p*-Alkylstyrenes With an Aluminum Alkyl-Titanium Trichloride Catalyst. ***C. G. Overberger and F. Ang.*** *American Chemical Society, Journal,* v. 82, Feb. 20, 1960, p. 929-933.

7252 Hardness, Abrasion, and Wear Resistance Testing of Plastics. Available methods of testing for these three properties are reviewed, along with a discussion of interpretation and applicability of the results. ***Ladislav Boor.*** *ASTM Bulletin,* no. 244, Feb. 1960, p. 43-47.

7253 Ethylene-Butene Copolymers. The 0.95 density ethylene-butene copolymers now available combine high stiffness and toughness, excellent stress-cracking resistance, and superior performance under long-term loads. Offer possibilities in such applications as detergent bottles, fibers, wire and cable coatings, and injection molding. ***J. E. Pritchard, R. M. McGlamery, and P. J. Boeke.*** *British Plastics,* v. 33, Feb. 1960, p. 58-61.

7254 Overcoming Sinkage and Voids in Thick-Section Mouldings. Production of thick-section moldings from polystyrene by conventional high pressure and low pressure injection techniques, and from nylon by high pressure injection molding. ***K. R. Lawrence and P. B. Wright.*** *British Plastics,* v. 33, Feb. 1960, p. 66-69.

7255* The Primary Process in the Mercury-6($^3P_1$)-Photosensitized Polymerization of Acetylene. The technique of monoisotopic Hg photosensitization in natural Hg vapor was used to determine the extent to which Hg consumption occurs in the primary reaction. Apparently a mercury carbide is formed. ***Alden G. Sherwood and Harry E. Gunning.*** *Canadian Journal of Chemistry,* v. 38, Mar. 1960, p. 466-467.

7256* Degradation of Linear Polymers. A system in degradation was considered, and to the bonds of trimer and of dimer reaction rates were assigned, different from those of the higher polymers. The agreement with experimental data is excellent: however, this is not considered sufficient to establish the relative stability of the bonds examined. (*In Italian.*) Degradazione di polimeri lineari. ***Ippolito Sorgato.*** *Chimica e l'Industria,* v. 42, Jan. 1960, p. 1-6.

7257 Anionic Polymerization of α-Methyl Styrene. III. Molecular Weight Determinations on Sharp Distribution Polymers. Poly-α-methyl styrene samples were prepared using sodium naphthenide as catalyst in tetrahydrofuran at −78 C. Molecular weights of the polymers were measured using osmotic pressure, light-scattering, and vapor-pressure depression techniques. Results indicate that the polymers have a very sharp molecular weight distribution. ***A. F. Sirianni, D. J. Worsfold and S. Bywater.*** *Faraday Society, Transactions,* v. 55, Dec. 1959, p. 2124-2129.

7258* Ultra-Violet Light Absorbers. Their Use in Plastics. *Fibres and Plastics*, v. 21, Feb. 1960, p. 44-47.

7259* Stabilisation of Polyvinyl Chloride. Useful stabilizing materials are described. *Fibres and Plastics*, v. 21, Feb. 1960, p. 47 + 4 pages.

7260 Fracture Phenomena in Polymers. The effects of some variables on the fracture morphology of polymers, particularly polymethyl methacrylate, are discussed. These include rate of loading, molecular weight, temperature, and orientation. Examples of several types of flaws observed in polymers are shown, and their significance is discussed. The observance of colors associated with fracture markings on polymethyl methacrylate is reported. ***I. Wolock, J. A. Kies, and S. B. Newman.*** Paper from "Fracture", p. 250-264, 1959. John Wiley & Sons, New York. (TA405 In8f)

7261* The Mechanism of Polyethylene Oxidation. At any temperature both chain scission and crosslinking occur simultaneously. The rate of oxidation is accelerated by increasing temperature, unsaturation, and branching. Molecular weight seems to have no effect. ***B. Baum.*** *Journal of Applied Polymer Science*, v. 2, no. 6, Nov.-Dec. 1959, p. 281-288.

7262* Anisotropy in Thermoplastic Moldings and Their Impact Strength. The effect of several dart drop test variables, such as drop height, dart tip radius, and specimen size were investigated. It was concluded that the conventional strength measurement of injection-molded specimens may lead to erroneous appraisal of the practical strength of a material. ***Henno Keskkula and J. W. Norton, Jr.*** *Journal of Applied Polymer Science*, v. 2, no. 6, Nov.-Dec. 1959, p. 289-296.

7263* Effect of Oxygen Pressure on the Thermal Degradation of a Methylphenylsilicone. ***L. C. Scala, W. M. Hickam, and M. H. Loeffler.*** *Journal of Applied Polymer Science*, v. 2, no. 6, Nov.-Dec. 1959, p. 297-301.

7264* Photosensitive Polymers. I. Cinnamate Esters of Poly(vinyl Alcohol) and Cellulose. II. Sensitization of Poly(vinyl Cinnamate). I. ***L. M. Minsk, J. G. Smith, W. P. Van Deusen, and J. F. Wright.*** II. ***E. M. Robertson, W. P. Van Deusen, and L. M. Minsk.*** *Journal of Applied Polymer Science*, v. 2, no. 6, Nov.-Dec. 1959, p. 302-311.

7265* The Gelation of Plastisols: An Automatic Method for the Determination of Plastisol Temperature-Rheology Characteristics. A technique is described for the small-scale evaluation of plastisol formulations for molding, casting, coating, and foam applications. ***Harvey Alter.*** *Journal of Applied Polymer Science*, v. 2, no. 6, Nov.-Dec. 1959, p. 312-317.

7266* Mechanism of Antioxidant Action in the Stabilization of Hydrocarbon Systems. The mechanism of the chain-stopping action is discussed in terms of four different reactions. The participation of the antioxidant in the mechanism of inhibited thermal oxidation is reviewed. The hydrogen donation mechanism as the first step in the chain-stopping mechanism was investigated by observing the effect of replacing the active hydrogen of the antioxidant by deuterium. ***J. Reid Shelton.*** *Journal of Applied Polymer Science*, v. 2, no. 6, Nov.-Dec. 1959, p. 345-350.

7267 Polyalkylene Disulfides and Polysulfides Containing Silicon. Catalytic air oxidation of 1,3-di(2-mercaptoethyl)tetramethyldisiloxane and 1,3-di(3-mercaptopropyl)tetramethyl-disiloxane to form high molecular weight polydisulfides were carried out in a soap emulsion system. Higher temperatures of oxidation were found to result in significantly higher molecular weights for the polymers. ***P. V. Bonsignore, C. S. Marvel, and Sahadeb Banerjee.*** *Journal of Organic Chemistry*, v. 25, Feb. 1960, p. 237-240.

7268* Characterization of Polyolefins by Differential Thermal Analysis. Differential thermal analysis was used to study the solid-liquid transitions of four polyethylenes, an isotactic polypropylene, a series of ethylene-propylene copolymers, and a physical mixture of polyethylene and polypropylene. The thermograms obtained directly yield the transition temperatures. By calibration, heats and entropies of fusion were also derived from the thermograms. From the heats of fusion, the degree of crystallinity of these polymers was calculated. ***Bacon Ke.*** *Journal of Polymer Science*, v. 42, Jan. 1960, p. 15-23.

7269* Ultrasonic Degradation of Polystyrene. I. A Proposed Mechanism for Degradation. II. Experimental. I. ***G. Gooberman.*** II. ***G. Gooberman and J. Lamb.*** *Journal of Polymer Science*, v. 42, Jan. 1960, p. 25-48.

7270* 4-Vinylbenzenephosphonic Acid. The synthesis from 2-bromoethylbenzene is discussed. ***Richard H. Wiley and W. A. Trinler.*** *Journal of Polymer Science*, v. 42, Jan. 1960, p. 113-117.

7271* γ-Radiation-Induced Polymerization of Ethenesulfonamide. Ethenesulfonamide was converted to polymer at the rate of 75%/hr. at 4200 r/min. as compared to rates of 1-17%/hr. for other monomers under similar conditions. The polymer shows the viscosity characteristics of a polyelectrolyte and is estimated to have molecular weight of $\bar{M}_n$ 12,000 and M_w 50,000 from a preliminary evaluation of viscosity, osmotic, and light scattering data. ***Richard H. Wiley and David E. Gensheimer.*** *Journal of Polymer Science*, v. 42, Jan. 1960, p. 119-123.

7272* Infrared Study of Oxygenated Groups Formed in Polyethylene During Oxidation. The changes in the molecular structure of polyethylene during oxidation are studied. The presently accepted theory involves a free-radical process and is based largely on measurements of reaction kinetics with model compounds. By recording the infrared spectra of polyethylene samples during oxidation, it was possible to follow continuously the formation of various O-containing groups. ***J. P. Luongo.*** *Journal of Polymer Science*, v. 42, Jan. 1960, p. 139-150.

7273* Crystalline Modifications of Cellulose. IV. Determination of X-Ray Intensity Data. V. A Crystallographic Study of Ordered Molecular Arrangements. VI. Unit Cell and Molecular Symmetry of Cellulose I. IV. ***J. Mann, L. Roldan-Gonzalez, and H. J. Wellard.*** V. ***D. W. Jones.*** VI. ***D. G. Fisher and J. Mann.*** *Journal of Polymer Science*, v. 42, Jan. 1960, p. 165-194.

7274* The Effect of Polymer Dilution on Acid-Catalyzed Gelation of Partially *N*-Methylolcarbamoylethylated Polyvinyl Alcohol. The effect of polymer dilution on the acid-catalyzed gelation of partially *N*-methylolcarbamoylethylated polyvinyl alcohol was studied viscometrically and chemically. The result that the higher the degree of dilution the greater the extent of reaction at gelation, especially in the polymer concentration below 15% by weight, indicates that a certain increase of intramolecular crosslinking with dilution occurs. ***Y. Nakamura, T. Koide, and M. Negishi.*** *Journal of Polymer Science*, v. 42, Jan. 1960, p. 203-211.

7275* The Mechanisms of Radiation-Induced Changes in Vinyl Polymers. An investigation has been made to discover why some polymers degrade while others predominantly crosslink on exposure to high-energy radiation. The results confirmed that vinyl polymers containing a quaternary carbon atom degraded while the rest became crosslinked. Free radical mechanisms are proposed to explain the occurrence and the observed features of the radiation-induced degradation and crosslinking reactions. ***Audrey Todd.*** *Journal of Polymer Science*, v. 42, Jan. 1960, p. 223-247.

7276* The Choice of Flexible Tubing for Use in a Vacuum System. When rubber or plastics tubing is used in a vacuum system at pressures below 1 mm. Hg, it tends to emit vapors which raise the pressure, just as if there were a leak in the system. Measurements were made of the outgassing rates under various conditions of eight samples of tubing, including neoprene, nylon, PVC, and polythene. Nylon was found to be the most satisfactory material and neoprene the least satisfactory. ***A. T. J. Hayward.*** *Laboratory Practice*, v. 9, Feb. 1960, p. 95-98.

7277* Progress in the Stereospecific Polymerization. Results of research in the field of polymers with an ordered steric structure, obtained by stereospecific polymerization, are reported. Some of the results concern the relationship between steric structure and crystallinity; from these it results that a regular steric structure is a necessary, but not a sufficient condition for the crystallizability of the polymers. ***Giulio Natta.*** *Makromolekulare Chemie*, v. 35, Jan. 1960, p. 94-131.

7278* Some Aspects of Anionic Polymerization. Initiation of anionic polymerization by negative ions is discussed in terms of acid-base reactions. The differences between a conventional acid-base reaction and the initiation process are considered and elaborated on the basis of a few illuminating examples. The electron-transfer initiation is described in detail. ***M. Szwarc.*** *Makromolekulare Chemie,* v. 35, Jan. 1960, p. 132-158.

7279* On Caprolactam Polymerization. The mechanism of the alkaline polymerization of caprolactam is discussed. ***O. Wichterle.*** *Makromolekulare Chemie,* v. 35, Jan. 1960, p. 174-182.

7280* Linear and Cyclic Oligomers. A summary of the principles of oligomer chemistry and their importance to macromolecular chemistry. Recent advances concern above all the synthesis of chromatographically pure oligomers and the preparation of polymer-homologous cyclic oligomers in the pure state from polycondensates. (*In German.*) Lineare und cyclische Oligomere. ***M. Rothe.*** *Makromolekulare Chemie,* v. 35, Jan. 1960, p. 183-199.

7281 One-Shot Urethane Foam. Use of triethylenediamine as catalyst has significantly altered the production of urethane foams by eliminating a production step from the customarily used foam process. ***W. E. Erner, A. Farkas, and P. W. Hill.*** *Modern Plastics,* v. 37, no. 6, Feb. 1960, p. 107 + 6 pages.

7282 A New Acrylic Thermoplastic. Baker PL-11, a copolymer of α-methylstyrene and methyl methacrylate, is a clear, transparent, thermoplastic material, possessing excellent outdoor weatherability. It can be injection and compression molded and extruded. ***Charles H. Schramm and Joseph Briskin.*** *Modern Plastics,* v. 37, no. 6, Feb. 1960, p. 127 + 3 pages.

7283 Thermal and Shear Degradation in Polyethylene Extrusion. Molten polyethylene resists shear degradation under normal extrusion conditions. Degradation occurs only at higher temperatures. Repeated extrusions of two low-density polyethylene resins at 400 and 504 F did not change their melt viscosity or intrinsic viscosity. Repeated extrusions of a third low-density resin at 646 F reduced the viscosity continuously. ***Hans Schott and W. S. Kaghan.*** *Modern Plastics,* v. 37, no. 7, Mar. 1960, p. 116 + 5 pages.

7284 Rheological Study of Vinyl Calendering Compounds. The effects of molecular weight and plasticizer content on the rheological properties of polyvinyl chloride compounds at several processing temperatures were studied with the shearing disk (Mooney) viscometer. ***W. E. Wolstenholme and P. E. Roggi.*** *Modern Plastics,* v. 37, no. 7, Mar. 1960, p. 131 + 5 pages.

7285 Olefin and Terpene Epoxides. Reactive diluents for epoxy resin formulations. ***R. J. Gall, J. J. Rizzo, and H. M. Castrantas.*** *Modern Plastics,* v. 37, no. 7, Mar. 1960, p. 137 + 6 pages.

7286* Match Polystyrene Properties/Threaded Closure Performance Needs. To determine which type of polystyrene is best suited to answer the property requirements of a single closure application, the designer or packaging engineer must be able to relate the several types to the properties which are most important in his closure design. The major functional properties of polystyrene materials are discussed. ***J. W. Mighton and R. E. Pfister.*** *Package Engineering,* v. 5, Mar. 1960, p. 58 + 4 pages.

7287 Dielectric Relaxation in High Polymers. II. Vinylic High Polymers. In vinylic high polymers, there are two absorption mechanisms; one is at high temperatures and the other at low temperatures. It is possible to separate the motion of a high polymer molecule into two distinct modes, rotation and vibration. The high temperature absorption is attributed to the rotational relaxation and the low temperature absorption to the vibrational relaxation. ***Tomoyasu Tanaka and Yōichi Ishida.*** *Physical Society of Japan, Journal,* v. 15, Feb. 1960, p. 261-269.

7288 The Welding and Fabrication of High Density Polythene. ***O. P. Phillips.*** *Plastics (London),* v. 25, Feb. 1960, p. 49-51.

7289* Oxidation In Extrusion. Proper extrusion equipment and operating conditions affect oxidation of polyethylene extrusions. ***R. C. Phelps and R. F. Koweal.*** *Plastics Technology,* v. 6, Mar. 1960, p. 31-33.

7290* The Polymerization of Acetylene in Solid-Gas Fluidized System. Experiments of polymerization of acetylene to benzene in solid-gas fluidized system were carried out in a range of temperature from 575 to 670 C. Silica sand was used as fluidized solid. Results show the advantage of using the fluidization technique as far as selectivity of the process studied is concerned. (*In Italian.*) Sulla polimerizzazione dell'acetilene in sistema fluidizzato: solido-gas. ***Leopoldo Massimilla, Antonio Cabella, and Enrico Dimarzio.*** *Ricerca Scientifica,* v. 29, Dec. 1959, p. 2582-2588.

7291* Fillers in Cross-Linked Polyethylene. Compares physical and electrical properties of medium thermal black-filled, cross-linked polyethylene with natural ground calcium-carbonate-filled, cross-linked polyethylene; describes the changes in physical and electrical properties of these compositions as the degree of cross-linking is varied, by altering either the quantity of cross-linking agent or the length of cure. ***W. F. Abbey, B. C. Carlson, and R. T. Zimmerman.*** *Rubber Age,* v. 86, no. 5, Feb. 1960, p. 837-840.

7292* Stereospecific Polymers in U.S.A. and Europe. A brief survey of industrial developments in the fields of stereospecific tire rubbers and polyolefin plastics. *Rubber and Plastics Age,* v. 41, Feb. 1960, p. 152-154.

7293* Soluble Catalysts for Ethylene Polymerisation. The reaction of bis-(cyclopentadienyl)-titanium dichloride and alkylaluminum compounds was studied. ***David S. Breslow, Wendell P. Long, and Norman R. Newburg.*** *Rubber and Plastics Age,* v. 41, Feb. 1960, p. 155 + 4 pages.

7294* Allowable Stresses and Quality Control of Rigid PVC Pipes. ***A. A. Van Der Wal and S. Heyer.*** *Rubber and Plastics Age,* v. 41, Feb. 1960, p. 169 + 5 pages.

7295* Polythene. II. History, Structure and Properties. ***L. Hinds.*** *Rubber Journal and International Plastics,* v. 138, no. 7, Feb. 13, 1960, p. 231 + 2 pages.

7296* Polythene. III. Injection Moulding. ***L. Hinds.*** *Rubber Journal and International Plastics,* v. 138, no. 8, Feb. 20, 1960, p. 268 + 3 pages.

7297* Crystallization of High Polymers. New aspects of crystal formation. *Rubber Journal and International Plastics,* v. 138, no. 11, Mar. 12, 1960, p. 391-392.

7298* Epoxy Resin Laminates With High Thermal Resistance. Improved and simplified techniques for using pyromellitic dianhydride to prepare glass-reinforced laminates with outstanding thermal resistance are reported. ***R. O. Menard and W. W. Cooner.*** *SPE Journal,* v. 16, Mar. 1960, p. 277 + 3 pages.

7299* Acrylic Polymers for Use in Rigid and Semi-Rigid Vinyl Compounds. ***Robert P. Hopkins.*** *SPE Journal,* v. 16, Mar. 1960, p. 304-310.

7300* New Curing Agents for Epoxy Resins. The boron-containing complexes have found application in the epoxy resin technology as curing agents and as accelerators. ***Henry Lee and Kris Neville.*** *SPE Journal,* v. 16, Mar. 1960, p. 315-318.

7301* Theory of Formation of Polymer Crystals With Folded Chains in Dilute Solution. A detailed interpretation of the kinetics of homogeneous nucleation and growth of crystals of a linear homopolymer from dilute solution is given. The probability of forming both nuclei with folded chains, and conventional bundlelike nuclei, from dilute soltuion is analyzed. ***John I. Lauritzen, Jr. and John D. Hoffman.*** *U. S. National Bureau of Standards, Journal of Research, Section A, Physics and Chemistry,* v. 64A, no. 1, Jan.-Feb. 1960, p. 73-102.

7302* On the Welding of Rigid Thermoplastic High Polymers. I. The Effect of Welding Conditions on the Welding Process. II. Effect of the Polymer Properties on the Weld. The strength of the weld is shown to increase with pressure, duration of the welding process, and welding temperature. It also increases with increasing plasticizer content owing to facilitation of the self-diffusion of the macromolecules and

their segments. (*In Russian.*) O svarivanii zhestkikh termoplasticheskikh polimerov. I. Vliianie uslovīĭ svarki. II. Vliianie svoĭstv. ***N. A. Grishin and S. S. Voiutskiĭ.*** *Vysokomolekuliarnye Soedinenitia*, v. 1, no. 12, Dec. 1959, p. 1778-1794.

7303* Chemically Cross-Linked Polyethylene for Wire and Cable—Progress Report. ***Michael M. Suba, L. G. Imhof, A. E. Tarbox, and F. J. Crimi.*** *Wire and Wire Products*, v. 35, Feb. 1960, p. 195 + 3 pages.

POLLUTION AND WASTES

7304* Contaminant Concentrations in the Atmosphere of Los Angeles County. ***Walter J. Hamming, Robert D. MacPhee, and James R. Taylor.*** *Air Pollution Control Association, Journal*, v. 10, no. 1, Feb. 1960, p. 7-16.

7305* Eye Irritation From Air Pollution. ***C. H. Hine, et al.*** *Air Pollution Control Association, Journal*, v. 10, no. 1, Feb. 1960, p. 17-20.

7306* Evaluation of Methods for Controlling Vehicular Exhaust. ***Wallace Linville, Raymond G. Holmes, and Carl V. Kanter.*** *Air Pollution Control Association, Journal*, v. 10, no. 1, Feb. 1960, p. 21-28.

7307* Effect of Biological Growths on Assimilative Capacity of Streams. ***H. Heukelekian.*** *Pulp and Paper Magazine of Canada*, v. 2, Feb. 1960, p. 42-44.

7308* Mechanical Reaeration to Increase Reoxygenation. Presents results of aeration tests conducted with two types of rotary aerators, designed for possible application in aeration of streams polluted by oxidizable matter and in treatment of sewage by bio-oxidation. ***Stefan A. Zieminski, Frederick J. Vermillion, Jr., and Bruce St. Ledger.*** *Pulp and Paper Magazine of Canada*, v. 2, Feb. 1960, p. 52-60.

7309* The Effects of Pulp and Paper Mill Wastes on Aquatic Habitat Requirements. ***Willis M. Van Horn.*** *Pulp and Paper Magazine of Canada*, v. 2, Feb. 1960, p. 67-69.

7310* Factors Affecting Slime Growth in the Lower Columbia River and Evaluation of Some Possible Control Measures. Of the environmental factors, the most important from the standpoint of slime growth in the Columbia River appear to be velocity, temperature and phosphate content. Optimum growth occurs within a temperature range of about 8 to 14 C and growth is at a minimum during the summer months. Phosphate concentrations appear to become critical and may limit slime growth during the summer and early fall. Optimum slime growth is obtained under a continuous feeding schedule, although the nutrient levels may be extremely low. Intermittent discharge of spent sulfite liquor for 24 hours followed by five days of storage was very effective in reducing slime growth. ***H. R. Amberg and J. F. Cormack.*** *Pulp and Paper Magazine of Canada*, v. 2, Feb. 1960, p. 70-80.

7311* Joint Industry and City Waste Treatment: Combined Approach as Viewed by Industry. ***George P. Schrader.*** *Water Pollution Control Federation, Journal*, v. 32, Feb. 1960, p. 157-163.

7312* Utilization of Spent Sulfite Liquor. Operating results for the torula yeast plant at Rhinelander Paper Co. show a 60% reduction in BOD of the spent sulfite liquor treated. However, reduction in the sugar content of the liquor approaches 90%. The lower figure for BOD reduction is due to the fact that there are significant quantities of BOD producing substances in the liquor which are not assimilated by the yeast cells. ***J. M. Holderby and W. A. Moggio.*** *Water Pollution Control Federation, Journal*, v. 32, Feb. 1960, p. 171-181.

7313* Wastes From the Processing of Corn Chips. ***Ralph Porges.*** *Water Pollution Control Federation, Journal*, v. 32, Feb. 1960, p. 182-185.

See also: **6332** (phthalic anhydride fume disposal); **6731** (diesel smoke); **6900** (fumes from open-hearth furnace).

RUBBER AND ELASTOMERS

7314* Rubber Promises Well in Road Surfacing. A discussion of the advantages of using rubber in bituminous road surfacings. *Engineering*, v. 189, Feb. 19, 1960, p. 246.

7315 Synthetic Rubber Production. Chelating Agents in Sulfoxylate Polymerization. EDTA is unique in its capacity to sustain sulfoxylate polymerization reactions activated by low Fe levels. Utilization of the most economical form of this agent in the proper amount offers synthetic rubber producers a possible avenue of economy. ***A. K. Prince and R. D. Spitz.*** *Industrial and Engineering Chemistry*, v. 52, Mar. 1960, p. 235-238.

7316 Delayed Action Accelerators for Vulcanizing Rubber . . . Preparing N-Alkyl- and N-Cycloalkylbis(2-benzothiazolesulfen)amides. Purer accelerators which have more effective delayed action can be obtained by improving conditions for their preparation. The two best procedures for preparing bis(2-benzothiazolesulfen)amides and procedure for demonstration of a side reaction are given. ***Norman K. Sundholm.*** *Industrial and Engineering Chemistry*, v. 52, Mar. 1960, p. 239-240.

7317 Rolling Friction of Polymeric Materials. I. Elastomers. Coefficients of friction for the rolling of steel balls on butyl, silicone, and Neoprene elastomers were measured in the temperature range of 25 to 100 C. The high mechanical losses and rolling friction for the butyl elastomer drop sharply on increasing the temperature. For the silicone and the Neoprene the losses and the friction decrease only slightly. ***Donald G. Flom.*** *Journal of Applied Physics*, v. 31, Feb. 1960, p. 306-314.

7318* Determination of Degree of Crosslinking in Natural Rubber Vulcanizates. IV. Stress-Strain Behavior at Large Extensions. By use of a non-Gaussian statistical theory, a relation is obtained between the extension ratio λ^*, the extension at which departures are small but significant, and the degree of crosslinking. It is shown that the additional determination of λ^* permits the calculation of both the degree of crosslinking and the extent of network flaws due to chain ends, from a single simple extension stress-strain curve. The calculation of these two basic parameters has hitherto been unattainable from measurements on vulcanized rubbers alone. ***L. Mullins.*** *Journal of Applied Polymer Science*, v. 2, no. 6, Nov.-Dec. 1959, p. 257-263.

7319* A Modification of the Method of Intermittent Stress Relaxation Measurements on Rubber Vulcanizates. The method of continuous and intermittent stress relaxation measurements on rubber vulcanizates was modified by introduction of intermittent tangent modulus measurements during the continuous relaxation experiments. This allows rate of scission and crosslinking to be determined simultaneously and on the same specimen. ***Svein Ore.*** *Journal of Applied Polymer Science*, v. 2, no. 6, Nov.-Dec. 1959, p. 318-321.

7320* The Mechanism of Radiation Damage to Elastomers. II. Crosslinking and Antirad Action. The effect of antirads on the crosslink yields in black-loaded natural rubber stocks during gamma irradiation was measured. The crosslink yields were determined by swelling techniques. Antirads decrease the crosslink yields if O_2 is absent. Oxygen alone effectively decreases crosslink yields. ***Richard G. Bauman.*** *Journal of Applied Polymer Science*, v. 2, no. 6, Nov.-Dec. 1959, p. 328-332.

7321* A Loss in Curing Test for Tire Cords. A laboratory method for determining effect of curing conditions on tensile strength of tire cords makes use of rubber-cord pads cured in a mold. Tensile strengths of the cured cords embedded in rubber are measured after removal from the mold. Tensile strength losses during curing of nylon were found to be caused by shrinkage of the cords in the presence of moisture. ***S. L. Reegen and J. Sabo.*** *Journal of Applied Polymer Science*, v. 2, no. 6, Nov.-Dec. 1959, p. 337-339.

7322* Failure of Foamed Elastic Materials. A theoretical treatment is given which predicts the tear strength of a foamed elastic material. Measurements of the tear strength, tensile strength, and elongation at break are described for natural rubber foams prepared from latex. It is concluded that uni-

formity of pore size is required for maximum strength, and a large average pore size for high tear resistance. ***A. N. Gent and A. G. Thomas.*** *Journal of Applied Polymer Science*, v. 2, no. 6, Nov.-Dec. 1959, p. 354-357.

7323* The Protection of Transparent Vulcanizates Against Ageing in Sunlight. An evaluation of vulcanizates in which the phenol and UV absorber have been incorporated before cure. ***J. R. Dunn and S. G. Fogg.*** *Journal of Applied Polymer Science*, v. 2, no. 6, Nov.-Dec. 1959, p. 367-368.

7324* New Materials for Tire Cord. New fibers are being developed to supplement and perhaps replace rayon and nylon tire cords. Here is a survey of the most promising among them with some facts on their good points and weaknesses. ***C. A. Litzler.*** *Modern Textiles Magazine*, v. 41, Mar. 1960, p. 24 + 4 pages.

7325* The Structure of Dispersed Carbon Blacks. A newly developed electrical approach measures the rate and magnitude of structure formation. ***Andries Voet and W. N. Whitten, Jr.*** *Rubber Age*, v. 86, no. 5, Feb. 1960, p. 811-818.

7326* Elastomers for Use in Radiation Fields. VI. Radiation Resistance of the Neoprenes. The radiation resistance of six of the more commonly used neoprene polymers and how they are affected by some compounding ingredients. ***Robert Harrington.*** *Rubber Age*, v. 86, no. 5, Feb. 1960, p. 819-825.

7327* Temperature Coefficient of Vulcanization of Butyl Rubber. Determined for butyl rubbers with different unsaturation levels and for butyl compounds employing different accelerator systems. Elastic modulus measurements and measurements of equilibrium volume swell were used to determine state of cure. ***J. G. Martin and R. F. Neu.*** *Rubber Age*, v. 86, no. 5, Feb. 1960, p. 826-832.

7328* Elevated Temperature Method for Determining Mooney Viscosity of Butyl Rubber. The method is applicable for polymers of high molecular weight. ***V. B. Calhoun, J. R. Reed, and R. M. Mineo.*** *Rubber Age*, v. 86, no. 5, Feb. 1960, p. 834-836.

7329* Compounding Transparent Rubber. Silica-loaded butyl compounds developed with such good transparency that an important use may develop for them in the tire manufacturing industry. ***Ralph F. Wolf and C. C. Stueber.*** *Rubber Age*, v. 86, no. 6, Mar. 1960, p. 1009-1016.

7330* Attrited Carbon Blacks and Their Behavior in Elastomers. I. The Attrition Process and Its Effect on Carbon Blacks. Experimental techniques employed for severe attrition of the blacks and how their properties are changed by this process. ***A. M. Gessler.*** *Rubber Age*, v. 86, no. 6, Mar. 1960, p. 1017-1024.

7331* Systematic Control of Rubber-to-Metal Adhesion in the Wire and Cable Industry. Basic elements in rubber-to-metal bonding as they apply to the wire and cable industry. ***Richard P. Stout.*** *Rubber Age*, v. 86, no. 6, Mar. 1960, p. 1025-1027.

7332* Design and Application of Latex-Coated Cables for Missile Systems. Latex compounding for insulation, coating and vulcanizing cycle, custom production for missiles. ***W. K. Priestley, E. J. D'Aquanno, and C. J. Tappero.*** *Rubber Age*, v. 86, no. 6, Mar. 1960, p. 1028-1032.

7333* The Low Temperature Properties of Natural Rubber as Affected by Reaction With Thiol Acids. The tendency of natural rubber to crystallize at low temperatures can be considerably reduced by the reaction of natural rubber with relatively small quantities of a thiol acid of the RCOSH type. A simple admixture with dry natural rubber is sufficient. The reaction can also be carried out in solution or in latex. If the thiol acid rubber vulcanizates are reinforced with C blacks, the tensile and tear strengths are much improved. ***F. J. Ritter.*** *Rubber Chemistry and Technology*, v. 33, no. 1, Jan.-Mar. 1960, p. 1-41.

7334* Hysteresis Losses in the Friction of Lubricated Rubber. Resistance to sliding on wet or slippery road surfaces may be considerably increased by using a tire rubber which maintains a high hysteretic loss over the range of speeds and temperatures developed during operation. In order to reduce the tendency to overheat, a duplex structure is suggested in which the body of the tire has low losses while the tread has high losses. ***David Tabor.*** *Rubber Chemistry and Technology*, v. 33, no. 1, Jan.-Mar. 1960, p. 142-150. (Reprinted from the "Proceedings of the First International Skid Prevention Conference, Virginia Council of Highway Investigation and Research, Charlottesville, Va., 1959, p. 211-218.)

7335* The Role of Free Radicals in Low Temperature Vulcanization of Butadiene Rubber. The vulcanization systems used were: 2-benzothiazolyl disulfide (MBTS)/H_2S, benzoyl peroxide/H_2S, SO_2/H_2S, systems which are sources of nascent S at room temperature. ***B. A. Dogadkin and E. N. Belyaeva.*** *Rubber Chemistry and Technology*, v. 33, no. 1, Jan.-Mar. 1960, p. 199-207. (Translated from *Vysokomolekuliarnye Soedineniia*, v. 1, no. 2, 1959, p. 315-323.)

7336* Factice in Nitrile Rubber Compounds. In the course of work designed to assess the help obtainable from the use of vulcanized fatty oil (factice) in compounding a nitrile rubber, experiments were carried out with a polymer based on 45 acrylonitrile/55 butadiene, using a high loading of SRF black in the presence of an ester plasticizer. The use of factice was found to give several advantages. ***C. Falconer Flint.*** *Rubber Journal and International Plastics*, v. 138, no. 7, Feb. 13, 1960, p. 235 + 2 pages.

7337* Crystallization-Inhibited Natural Rubber. Production by Reaction With Butadiene Sulphone. Methods of modifying natural rubber to retard the rate of crystallization several hundredfold are briefly described. ***P. McL. Swift.*** *Rubber Journal and International Plastics*, v. 138, no. 10, Mar. 5, 1960, p. 348 + 2 pages.

7338* New Rubber Processing Technique for the Sixties. The two-roll mill can be made automatic with greatly increased performance capabilities for plasticizing and mixing rubber stocks by the addition of certain special equipment, and it could be operated at higher-than-normal speeds. ***Andrew Hale.*** *Rubber World*, v. 141, no. 6, Mar. 1960, p. 815-819.

7339* Storage Stability of Tread Rubber and Tire Repair Materials. The maximum aging temperature at which reasonable estimations of probable shelf life can be determined is in the vicinity of 150 F, but definitely below 200 F. Results at 125 F appeared to be somewhat more reliable than those obtained at 150 F, but a longer aging period was required. ***R. D. Juve and F. M. Johnson.*** *Rubber World*, v. 141, no. 6, Mar. 1960, p. 820-826.

7340* Compounding "Viton" for High-Pressure, High-Temperature Applications. Description of how the proper choice of compounding ingredients together with a slight copolymer modification helped solve a problem connected with the use of "Viton" fluoroelastomer in high-temperature applications. ***G. A. Gallagher, T. D. Eubank, and A. L. Moran.*** *Rubber World*, v. 141, no. 6, Mar. 1960, p. 827-832.

7341 Power Loss and Operating Temperature of Tires. The power loss of pneumatic tires was measured under steady-state conditions by means of two dynamometers, one of which measured the total power input and the other power output. ***R. D. Stiehler, M. N. Steel, G. G. Richey, J. Mandel, and R. H. Hobbs.*** *U. S. National Bureau of Standards, Journal of Research, Section C, Engineering and Instrumentation*, v. 64, no. 1, Jan.-Mar. 1960, p. 1-11.

SPACE HEATING AND CONDITIONING

7342* The Engineer Looks at Direct Fired Radiant Heating. Discusses advantages and limitations of overhead radiant heat units. ***H. I. Miller, Jr.*** *Air Conditioning, Heating and Ventilating*, v. 57, Mar. 1960, p. 65-68.

7343* Refrigerant Piping Hookups for Parallel Compressors. Discusses some of the engineering principles that govern this application, and presents examples of what is considered improper and preferred refrigerant piping hookups.

J. R. Harnish. *Air Conditioning, Heating and Ventilating,* v. 57, Mar. 1960, p. 69-73.

7344* Air Distribution for Air Conditioning. ***John W. Markert.*** *Air Conditioning, Heating and Ventilating,* v. 57, Mar. 1960, p. 75-83.

7345* Methods for Hanging Ducts. ***Willard C. Janes.*** *Air Conditioning, Heating and Ventilating,* v. 57, Mar. 1960, p. 89-90.

7346* Better Air for Industry. IV. Investigates high efficiency centrifugals, dry type dynamics, unit collectors, and their costs. ***Richard V. Sloan.*** *Air Engineering,* v. 2, no. 3, Mar. 1960, p. 34-36.

7347* What You Should Know About Respirators. II. Second of a series on industrial dusts, gases and vapors . . . and the respirators to protect against them. ***H. H. Fawcett.*** *Air Engineering,* v. 2, no. 3, Mar. 1960, p. 39 + 2 pages.

7348* Heat Transfer in Ductwork. Describes problems raised by heat transfer through duct sides, condensation, and alternate heating and cooling, and discusses ways to avoid them. ***C. O. Wood.*** *Air Engineering,* v. 2, no. 3, Mar. 1960, p. 46-48.

7349 5 Years of Operational Experience Prove Air-to-Air Heat Pump To Be Effective in Northern Climate. This installation is in a residence in Pullman, Washington. ***James S. Englund.*** *ASHRAE Journal,* v. 2, Mar. 1960, p. 56 + 4 pages.

7350 Air Conditioning as Applied to Aircraft, Missiles and Rockets. Outlines problems involved in air conditioning of aircraft, missiles, and rockets, and compares them with problems encountered in the design of conventional air conditioning systems. ***Robert Berner.*** *ASHRAE Journal,* v. 4, Mar. 1960, p. 62-68.

7351* Industrial Air Conditioning. ***O. T. Zimmerman and Irvin Lavine.*** *Cost Engineering,* v. 5, no. 1, Jan. 1960, p. 16-17.

7352 It's Contractor's Duty to Advise Owner of Problems Leading to Poor Operation. ***John F. Morrissey.*** *Heating, Piping & Air Conditioning,* v. 32, Feb. 1960, p. 133.

7353 Flexible Connectors Cut Installation Costs of Tall Building Heating. Flexible metal pipe connectors are one solution to an inherent problem faced by designers of baseboard and finned pipe steam and hot water heating systems for tall buildings: that of how to make connections to the risers in the tight space available and still allow for expansion. ***Lewis Smith.*** *Heating, Piping & Air Conditioning,* v. 32, Mar. 1960, p. 118-120.

7354 A Study in Contrast: How Shipboard Air Conditioning Compares to Land Installations. The structural requirements of a ship and its infinite mobility present considerations which impose unique design problems. Some of these problems and the means taken to compensate for them are discussed in this article. ***John W. Markert.*** *Heating, Piping & Air Conditioning,* v. 32, Mar. 1960, p. 134-137.

See also: **6338** (plant electrical heating).

TEXTILES, FIBERS, LEATHER, AND PAPER

7355* The Isolation of Elastic Tissue of Animal Skin. ***Conrad L. Ornes and William T. Roddy.*** *American Leather Chemists Association, Journal,* v. 55, Mar. 1960, p. 124-128.

7356* An International Look at . . . Glues and Gluing, 1959. This review summarizes new developments in wood glues in the U. S., Canada, Great Britain, Sweden, Germany, and Japan. ***R. F. Blomquist.*** *Forest Products Journal,* v. 10, Feb. 1960, p. 62-70.

7357* Problems and Practices in Wood Preservation, 1958-9. ***C. S. Walters.*** *Forest Products Journal,* v. 10, Feb. 1960, p. 73-81.

7358* Review of Chemical Utilization. Complete literature surveys on the chemistry of lignin and wood extractives. Comprehensive reviews on bark and bark extractives, plus sections on pulping, charcoal, and wood hydrolysis. ***Irwin A. Pearl and John W. Rowe.*** *Forest Products Journal,* v. 10, Feb. 1960, p. 91-112.

7359* 1959 Summary of Wood Finishing Developments. ***D. G. Lubeck.*** *Forest Products Journal,* v. 10, Feb. 1960, p. 113-118.

7360* Surface-Texture Measurements for Quality and Production Control. . . . of wood products. ***Donald A. Stumbo.*** *Forest Products Journal,* v. 10, Feb. 1960, p. 122-124.

7361* Chemical Conversion of Wood Residues. III. Preparation and Properties of Hydroxymethylfurfural. A new procedure for obtaining experimental quantities of the material and a discussion of its properties. ***J. F. Harris, J. F. Saeman, and L. L. Zoch.*** *Forest Products Journal,* v. 10, Feb. 1960, p. 125-128.

7362* Chemical Properties of Modified Celluloses. Discusses only such modifications of cellulose as can be prepared from cellulose by means of oxidizing and reducing agents, and which therefore do not contain more C atoms than the initial cellulose, although the numbers of O and H atoms possibly vary to some extent. ***Hannes Sihtola.*** *Makromolekulare Chemie,* v. 35, Jan. 1960, p. 250-265.

7363 Physical Methods of Investigating Textiles. Describes experimental methods of determining the structure and physical properties of textiles. The emphasis throughout is on newer techniques, and many traditional methods which are well described elsewhere are omitted. Some of the subjects covered are fiber dimensions; density, moisture and swelling; yarn and fabric structure; transmission of heat, moisture and air; and frictional behavior of textiles. ***R. Meredith and J. W. S. Hearle, editors.*** 411 pp. 1959. Textile Book Publishers, Inc., New York. (TS1449 M54p)

7364* Evaluation of Waste Assimilation Capacity of Streams. Five major phases are usually entailed; determination of the magnitude and characteristics of the wastes, appraisal of the natural hydrologic setting, adoption and verification of self-purification factors involved, forecasts of stream conditions expected for ranges of waste loading under various probabilities of stream runoff, and critical appraisal of the impact of man-made river developments, existing and proposed. ***C. J. Velz.*** *Pulp and Paper Magazine of Canada,* v. 2, Feb. 1960, p. 34 + 8 pages.

7365 Textile Engineering Processes. Properties of fibers, yarns, and fabrics; opening; drawing; spinning; winding; beaming and sizing of yarns; weaving; knitting; water extraction, drying, and conditioning; dyeing and printing; automatic control theory and practice in textile engineering; air humidity and its control. ***A. H. Nissan.*** 366 pp. 1959. Textile Book Publishers, Inc., New York. (TS1445 N63t)

7366* The Spinning of Rayon as Related to Its Structure and Properties. ***Wayne A. Sisson.*** *Textile Research Journal,* v. 30, Mar. 1960, p. 153-170.

7367* New Silicone Alloy for Durable Water Repellency on Cotton. The alloy may be applied from organic solvents or aqueous emulsions. Greater permanence to laundering was obtained by the solvent method. Creaseproofing resins may also be incorporated in the formulation. ***Charles J. Conner, Wilson A. Reeves, and Leon H. Chance.*** *Textile Research Journal,* v. 30, Mar. 1960, p. 171-178.

7368* Cotton Cross-Linked at Various Degrees of Fiber Swelling. Cross-linking tends to fix or stabilize a fiber in a given state of swelling. There seems to be an optimum water content in the reaction system at the time of cross-linking for maximum dry and wet wrinkle recovery. A mechanism is presented diagrammatically to explain wet and dry wrinkle recovery. The mechanism is based upon H-bond cross links, covalent-bond cross links, and the position of the two types of cross links. ***Wilson A. Reeves, Rita M. Perkins, and Leon H. Chance.*** *Textile Research Journal,* v. 30, Mar. 1960, p. 179-192.

7369* The Cross-Linking of Cotton Cellulose With Quaternary Ammonium Derivatives of Bis Chlromethyl Ethers. ***Giuliana C. Tesoro.*** *Textile Research Journal,* v. 30, Mar. 1960, p. 192-201.

7370* New Developments in Epoxide Wash-Wear Finishes for Cotton. Epoxides differ as much from one another as they do from the conventional N-containing finishes. In general, however, they demonstrate resistance to chlorine retention and a high level of durability to all types of laundering, including that used by commerical laundries. ***John Galligan, Arnold M. Sookne, J. T. Adams, Jr., Howard Guest, and George H. Lourigan.*** *Textile Research Journal,* v. 30, Mar. 1960, p. 208-222.

See also: **6523** (corrugated board, super strength).

WELDING AND JOINING

7371 Design and Welding of Alloy Cast Steel. Steam Turbine Applications. The service requirements of modern steam turbine-generator equipment necessitate that castings and cast weldments be of the highest quality. The design, welding, and quality control aspects of high quality castings are discussed relative to greater participation by foundries in these important phases of manufacture. ***L. W. Songer.*** Paper from "American Foundrymen's Society, Transactions", v. 67, 1959, p. 281-289. American Foundrymen's Society, Des Plaines, Illinois. (TS200 Am35t Vis.)

7372 The Electric Arc in Welding. ***E. C. Rollason.*** *British Welding Journal,* v. 7, Feb. 1960, p. 71-72.

7373 Arc Characteristics and Their Significance in Welding. Survey of arc physics which relate to the chemicometallurgical reactions occurring between the arc atmosphere and the weld metal, heat transfer from the arc, and metal transfer in consumable electrode welding. ***D. R. Milner, G. R. Salter, and J. B. Wilkinson.*** *British Welding Journal,* v. 7, Feb. 1960, p. 73-88.

7374 Gas Absorption From Arc Atmospheres. The reaction between the high-temperature gases in the arc atmosphere and molten metal has been investigated for the absorption of O from an Ar-O atmosphere by Ti, the amount of O absorbed being determined by hardness surveys. ***G. R. Salter and D. R. Milner.*** *British Welding Journal,* v. 7, Feb. 1960, p. 89-100.

7375 Metal Transfer in Inert-Gas Shielded-Arc Welding. It is postulated that high-velocity plasma jets in the arc are responsible for metal transfer in high current density welding arcs. ***J. C. Needham, C. J. Cooksey, and D. R. Milner.*** *British Welding Journal,* v. 7, Feb. 1960, p. 101-114.

7376 Heat Transfer From Arcs. The energy distribution for arcs between a nonconsumable tungsten cathode and a water-cooled Cu anode has been determined in atmospheres of Ar, N, He, and H. ***J. B. Wilkinson and D. R. Milner.*** *British Welding Journal,* v. 7, Feb. 1960, p. 115-128.

7377 Effect of Arsenic on Weldability and Notch Toughness of Mild Steel (To A.P.I. Grade *B* Specification). The experimental evidence obtained suggests that arsenic up to and including 0.10% has no influence on weld crack susceptibility. *British Welding Journal,* v. 7, Feb. 1960, p. 129-140.

7378 Arc Torch Prepares Tank Seams. By eliminating prebeveling in welding tank seams, a new method simplifies fabrication. *Iron Age,* v. 185, no. 8, Feb. 25, 1960, p. 66-67.

7379* High-Temperature Brazing Experiments. Statistical analysis is suggested as a means of resolving discrepancies in results of similar fusion welding experiments. Details of a typical experiment illustrate the possibilities. ***R. R. Ruppender.*** *Metal Progress,* v. 77, no. 2, Feb. 1960, p. 95-97.

7380* Hot Melt Adhesives Stage a Comeback. ***Richard E. Smith.*** *Paper, Film and Foil Converter,* v. 34, Feb. 1960, p. 30 + 2 pages.

7381* Research on Soft Soldered Joints, a Contribution to the Development of Suitable Testing Methods for Static and Dynamic Strength. Influence of soldering temperature, soldering time, cooling rate, area of soldered face, size of gap, rest period and loading rate upon the tensile strength. Suggestion of a testing method for short-time strength; different strength measurements; investigation after aging the soldered joints at raised temperatures; comparison between furnace and hand soldering; and micro photographs taken with the electron microscope for the study of the jointing process. (*In German.*) Untersuchungen an Weichlötverbindungen als Beitrag zur Entwicklung geeigneter Prüfverfahren für die statische und dynamische Festigkeit. ***H. Koch and W. Wasserbach.*** *Schweissen und Schneiden,* v. 12, Jan. 1960, p. 2-10.

7382* Stored Energy Welding. Description of the method; advantages of welding with stored energy; physical principles; welding technology; welding electrodes; and welding equipment. (*In German.*) Das Kondensator-Impulsschweissen. ***F. Früngel.*** *Schweissen und Schneiden,* v. 12, Jan. 1960, p. 14-18.

7383 The Joining of Beryllium. Although Be must be regarded as a crack sensitive material, satisfactory conditions were obtained for fusion welds in all the joint designs with the exception of sheet butt welds. ***N. F. Eaton, J. Skinner, and A. J. Martin.*** *Welding and Metal Fabrication,* v. 28, Feb. 1960, p. 46-52.

7384 Automatic Welding in the U.S.S.R. A Russian Statement of Policy. A translation from a recent issue of the Russian journal, "Avtomaticheskaya Svarka". *Welding and Metal Fabrication,* v. 28, Feb. 1960, p. 69.

7385* Convair Butt Welds .002-Inch Stainless. The trend toward using thinner gage materials in missiles shows that missile manufacturers soon will have to make fusion butt welds in metals as thin as .001-inch and thinner. ***W. P. McGregor.*** *Welding Design & Fabrication,* v. 33, Feb. 1960, p. 34 + 1 page.

7386* How a Spot Weld Can Be Set up Mathematically. Mathematical formulas developed by Army Ballistic Missile engineers help them predetermine spot welding variables. Explains use of formulas to make better spot welds. ***James K. Dawson.*** *Welding Design & Fabrication,* v. 33, Feb. 1960, p. 46-48.

7387* Rohr Develops Techniques for Welding New High-Strength Nickel-Base Alloy. Tests on René 41 alloy show welds remain sound after stress has fractured parent metal. *Welding Design & Fabrication,* v. 33, Feb. 1960, p. 50 + 2 pages.

7388* Strengthened Building Supports New Steel. A face-lift operation to provide modern quarters for a TV station in an old building posed many structural problems. Here is how they were solved. *Welding Design & Fabrication,* v. 33, Feb. 1960, p. 53 + 1 page.

7389* Joint Design and Welding Procedures Are Keys to Fabrication of Feedwater Heaters. Here is what one company does to get high quality welded joints in feedwater heaters used in electric generating stations. *Welding Design & Fabrication,* v. 33, Feb. 1960, p. 54-57.

7390 The Importance of Polarity in Arc Welding. Polarity's effect on penetration patterns when fillet welding is usually slighted by design engineers. Discusses various factors to be considered when choosing between reverse or straight polarity. ***Bela Ronay.*** *Welding Engineer,* v. 45, Mar. 1960, p. 32-33.

7391 How to Determine Required Strength of Fillet Weld on Angles. When making fillet welds on angles, the weld joint must be proportioned properly to reduce internal stresses and strains. The method of determining the correct weld size and length for the most economical strength, joint efficiency and margin safety is given. ***Nicholas S. Hodska.*** *Welding Engineer,* v. 45, Mar. 1960, p. 37-39.

7392 Producing Accurate Poke Weld Fixtures. New tooling method uses glass cloth, epoxy resin to make accurate fixtures at low cost. ***Charles H. Miller.*** *Welding Engineer,* v. 45, Mar. 1960, p. 40-41.

7393 New Method Simplifies Fin-To-Tube Welding. High-frequency resistance technique called faster, more economical. *Welding Engineer*, v. 45, Mar. 1960, p. 42-43.

7394 Better Resistance Welds Through Double Acting Air Cylinder System. ***A. B. Palmer.*** *Welding Engineer*, v. 45, Mar. 1960, p. 62.

7395* Metallurgy of Bonding in Brazed Joints. III. The Role of Intermetallic Compounds in Brazed Joints. The occurrence and effects of intermetallic compound formation in brazed joints is investigated, utilizing low-carbon steel as base metal and Ag-Si, Ag-Zn and Ag-Sn alloys as filler metals. ***Nikolajs Bredzs and Harry Schwartzbart.*** *Welding Journal*, v. 39, Feb. 1960, p. 49S-58S.

7396* Effect of Magnetic Field on Transfer Characteristics of Particles in an Electric Arc. Transfer characteristics of metal particles under arc-blow conditions can be controlled by balancing the magnetic forces acting on the arc or offsetting their effects. ***Petro Shajenko.*** *Welding Journal*, v. 39, Feb. 1960, p. 83S-88S.

7397* Electroslag Welding—A New Process for Heavy Fabrication. Discusses a new process in which the heat necessary for fusing the filler metal and both sides of the joint is developed in the slag which covers the molten metal. ***R. David Thomas, Jr.*** *Welding Journal*, v. 39, Feb. 1960, p. 111-117.

7398* Ring-Projection Welding of Low-Carbon Steel Munitions. Helium-tight and impact-resistant seals can be effected when necessary consideration is given to joint design, electrode design, and weld schedule. ***Michael J. Welther and Salvatore M. Robelotto.*** *Welding Journal*, v. 39, Feb. 1960, p. 118-125.

7399* Automatic Welding Procedures for Sheet-Metal Stampings. Increased safety, higher product quality, greater operating convenience and lower production costs are among the many advantages of this process. ***H. A. Franke and E. R. Hubbard.*** *Welding Journal*, v. 39, Feb. 1960, p. 126-130.

See also: **7288** (welding of polythene).

MISCELLANEOUS

7400 Professions Organize in Michigan to Provide Mutual Advancement. The Michigan Association of the Professions, founded in 1958, includes engineers, doctors, dentists, lawyers, architects, etc. ***Nathaniel O. Saulter.*** *American Engineer*, v. 31, Feb. 1960, p. 36-37.

7401 The Meaning of Your Profession. II. Second part of a three-part series on "Engineering as a Profession" written by one of this country's most outspoken individuals. ***H. G. Rickover.*** *American Engineer*, v. 31, Feb. 1960, p. 39-42.

7402* The Relation Between Confidence Intervals and Tests of Significance. A Teaching Aid. ***Mary G. Natrella.*** *American Statistician*, v. 14, no. 1, Feb. 1960, p. 20 + 3 pages.

7403 Applied Descriptive Geometry. Purpose is to teach the analysis and solution of three-dimensional problems through application of the principles of orthographic, or multiview, projection. ***Frank M. Warner and Matthew McNeary.*** 5th Ed. 243 pp. 1959. McGraw-Hill, New York. (QA501 W24a5)

7404 Applied Mathematics for Engineers and Scientists. Chapter headings include: "Motion of a Particle in a Plane"; "Moments of Inertia"; "Small Oscillations and Vibrations"; and "Motion of a Fluid". ***C. G. Lambe.*** 518 pp. 1958. MacMillian Co., New York. (QA805 L17a)

7405 Automatic Teaching: The State of the Art. On December 8 and 9, 1958, the University of Pennsylvania and the Air Force Office of Scientific Research sponsored a first conference on the "Art and Science of the Automatic Teaching of Verbal and Symbolic Skills". This report presents several of the papers and abstracts that were read at the meeting. ***Eugene Galanter, editor.*** 198 pp. 1959. John Wiley & Sons, New York. (LB1029.A85 G13a)

7406 CERN as an Institute for International Cooperation. The director-general of CERN (European Center for Nuclear Research) explains the purpose and history of the center, which has evolved from a regional European enterprise into an international center for high energy physics. ***C. J. Bakker.*** *Bulletin of the Atomic Scientists*, v. 16, no. 2, Feb. 1960, p. 54-57.

7407 How to Live With the Bomb and Survive. The possibility of a Pax Russo-Americana in the Long-Range Rocket Stage of the so-called "Atomic Stalemate". Szilard envisages a "stabilized" state of unchallenged American and Soviet capacity for mutual destruction, provided by invulnerable long-range rockets with H warheads, rather than an unlimited arms race, or nuclear disarmament. ***Leo Szilard.*** *Bulletin of the Atomic Scientists*, v. 16, no. 2, Feb. 1960, p. 59-73.

7408 A National Peace Agency. The Democratic Party outlines a plan for establishing a National Peace Agency which would report directly to the President in much the same way as does the Atomic Energy Commission. *Bulletin of the Atomic Scientists*, v. 16, no. 2, Feb. 1960, p. 74-76.

7409 Can We Live in Babel? Discusses the confusions and anomalies in weights and measures which exist both between nations and technologies. Concludes that, with respect for the systems of others, we can live in Babel without undue hardship. ***Ralph A. Sherman.*** Paper from "System of Units; National and International Aspects", p. 229-233, 1959. American Association for the Advancement of Science, Washington, D. C. (QC88 Am35s)

7410 Codfish, Cats, and Civilization. Interrelationships between animals, birds, fish, and insects, and the progress of mankind. ***Gary Webster.*** 263 pp. 1959. Doubleday & Co., Garden City, N. Y. (QL85 G19c)

7411 Elementary Mathematics of Sets With Applications. The first objective is to construct a sequence of lessons which will introduce the ideas of sets in a correct, though intuitive, mathematical development. ***Robert L. Davis, editor.*** 168 pp. 1958. Mathematical Association of America, Buffalo, N. Y. (QA248 M42e)

7412 The Embattled Executive. A collection of cartoons on the tribulations of management which originally appeared in AMA's monthly magazine, *The Management Review*. ***Harwood F. Merrill.*** 94 pp. 1959. American Management Ass'n., New York. (HF5500 Am35em)

7413* Second-Order Non-Linear Difference Equations Containing Small Parameters. Presents a method for solving second-order non-linear difference equations containing small parameters. ***H. C. Torng.*** *Franklin Institute, Journal*, v. 269, no. 2, Feb. 1960, p. 97-104.

7414* Are We Confused About America's Direction? The president of American Motors Corp. discusses the problem of balancing and dispersing of power in the U. S. ***George Romney.*** *Franklin Institute, Journal*, v. 629, no. 2, Feb. 1960, p. 133-142.

7415 Germany Rejoins the Powers. Mass Opinion, Interest Groups, and Elites in Contemporary German Foreign Policy. Gives a brief summary of some of the main background conditions of German foreign policy since World War II. In addition, it compares and analyzes actual political behavior. Its investigation of opinion polls and the German elite class are important features. ***Karl W. Deutsch and Lewis J. Edinger.*** 320 pp. 1959. Stanford University Press, Stanford, California. DD259.4 D48g

7416* How to Appraise Executive Performance. By setting "planned performance" targets of quantitative and qualitative goals for the year ahead, management has a better criteria for judgment of executive performance than the old subjective approach provides. ***Arch Patton.*** *Harvard Business Review*, v. 38, no. 1, Jan.-Feb. 1960, p. 63-70.

7417* In Defense of Performance Appraisal. Although it has been suggested recently that there are serious problems in conventional procedures for appraising and interviewing subordinates, experiences indicate that while these dangers exist they are more theoretical than real. Furthermore, the possible trouble areas are minimized when the basic tools of management development are used with judgment. ***Harold Mayfield.*** *Harvard Business Review*, v. 38, no. 2, Mar.-Apr. 1960, p. 81-87.